City of San Antonio

TRANSPORTATION AND CAPITAL IMPROVEMENTS

ADDENDUM No. 2

FORMAL INVITATION FOR BIDS (IFB)

PROJECT NAME: INGRAM ROAD (CULEBRA ROAD TO MABE ROAD) – ID NO.:40-00307

DATE: October 22, 2014

This addendum is separated into sections for convenience; however, all contractors, subcontractors, material men, and other parties shall be responsible for reading the entire addendum. The failure to list an item or items in all affected sections of this addendum does not relieve any party affected from performing as per instructions, providing that the information is set forth one time any place in this addendum. These documents shall be attached to and become part of the Contract Documents for this project. The contractor shall be required to sign an acknowledgement of the receipt of this addendum and submit with their proposal package.

GENERAL:

1) The following changes and/or additions to the Contract Documents, via this addendum, shall apply to proposals made for and to the execution of the various parts of the work affected thereby.
2) Careful note of the Addendum shall be taken by all interested parties and all trades affected shall be fully advised in their performance of the work involved.

GENERAL COMMENTS:

1) SAWS Clarification: SAWS Water cover sheet has been revised to reflect the two line items added with addendum #1: "1015 Service Line Break Leak Repairs" & "1020 Water Main Breaks Leak Repairs". See attached revised sheet.

QUESTIONS FROM PROSPECTIVE BIDDERS:

1) On Bid Form 020, the totals do not follow the Bid Form 025. On Sheet 9 of Bid Form 025 the last line totals "Total (CoSA + SAWS + AA1) Bid Amount". This will total all of the bid-items including the Additive Alternate 1. However, on Form 020 the 4th Total down calls for "Total Amount of Base Bid) Insert amount in Words and Numbers)". The Bid Form 025 does not produce a Total that can be placed on the Form 020. Will this be corrected prior to bid time?
   a) The 020 Form will remain "as is". The total bid including the additive alternate will be calculated by city staff.

2) Is there a Geotechnical Report or Boring Log available for this project location?
   a) Yes. Please see attached Geotechnical Report.

3) Do you have an electronic earth-work file for this project?
   a) This information can be provided to the winning bidder prior to construction.

4) Can a pay item for police officers be added?
   a) General TCP Notes Item 1 states the following: "A peace officer, at the contractor's expense, shall direct traffic at Mabe rd and Potranco rd intersections during all lane closure operations associated with construction at the intersections." The city will only pay it as a force account, if it separate from normal traffic control operating procedures.

5) Please provide the by-pass pumping plan for SAWS-Sanitary Sewer.
   a) It is the contractor's responsibility to provide the Bypass Pumping Plan in accordance to SAWS specification 864 "Bypass Pumping". Please see SAWS specification 864 for submittal requirements. SAWS sewer plans do provide one option for the bypass pumping plan on sheet 5.

6) Sheet 33 Ph-1 Note 3, "Detectable Channelized Pedestrian Route"... could you please provide an example of this?
   a) Contractor will need to provide an ADA compliant route. The material to be used will need to be easily traversable by wheelchairs.

7) Have all the gas relocates been completed? What is the backfill material for the gas? Is it density control or flowable fill? If density control are there test results available?
   a) CPS will adjust their gas line (at approximately station 16+00) before construction. The gas line will be backfilled with flowable fill at approximately 5 feet deep and 1 feet wide trench. The gas line at station 13+00 will not need to be adjusted.

8) Sheet 257 Section B-B shows 12" CMP-there isn't a pay item that exists for this, can one please be added?
   a) Please see attached revised 025 form to include line item 404.1 12" CMP.

9) Sheet 258 indicates the use of flowable fill at the driveways for RCP. Will flowable fill be required at Add Alt 1-System D? L14 (Sheet 258) 24" RCP? L08 (sheet 246) 4x3 Box?
   a) No, flowable fill is only to be used on driveway structures with limited cover. Otherwise, backfill needs to be in accordance with Pipe & Bedding & Misc. Drainage Details.

10) There isn't a top elevation on Junction Box D22, can one please be provided?
   a) No, junction box will be placed to accommodate the flowlines of the structures flowing in and out of D22 and a top elevation is not needed.

11) How are the concrete median item and the adjacent concrete curb item going to be paid for? Is the concrete median paid from face of curb to face of curb or back of curb to back of curb? Is the concrete curb paid as LF of curb or is it incidental to the concrete median item?
   a) As per specification 504 "Concrete Medians and Islands", concrete medians are measured by the square yard to the face of curb. Curb is included within this item.

DOCUMENTS TO DELETE AND REPLACE WITH THE ATTACHED:

1) SAWS Water Cover Sheet: Added line item 1015 & 1020 (1 sheet)
2) Revised 025 Form: Added line item 404 Corrugated Metal Pipe (1 sheet) (Revised Excel Sheet)
3) Revised General Specifications: Added spec 404 Corrugated Metal Pipe (7 pages)
4) Revised Reconstruction Quantity sheet No. 22: Added line item 404 CMP (1 sheet)
5) Revised Reconstruction Quantity sheet No. 24: Added line item 1015 & 1020 (1 sheet)

OTHER DOCUMENTS ATTACHED:

1) Geotechnical Report (58 pages)
2) Acknowledgement Form- Addendum No. 2 (1 page)

ANNA P. ESQUIVEL, P.E. — DATE 10/22/14

STATE OF TEXAS
ANNA PATRICIA ESQUIVEL
117304
LICENSED
PROFESSIONAL ENGINEER

END OF ADDENDUM No. 2
October 22, 2014

10/21/2014 3:46:45 PM

SAN ANTONIO WATER SYSTEM

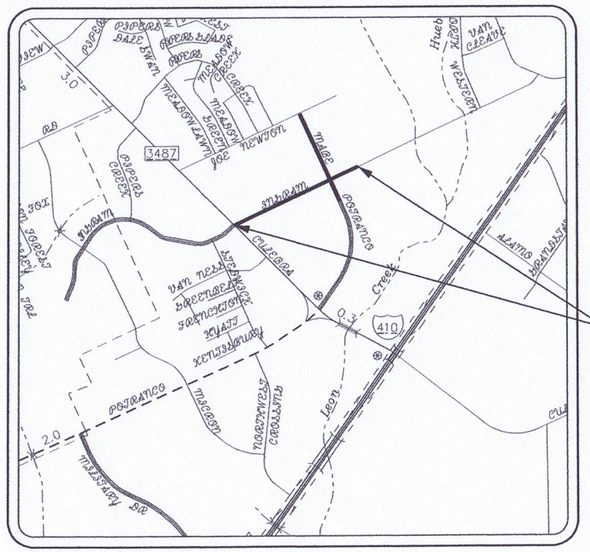
Lockwood, Andrews & Newnam, Inc.
A LEO A. DALY COMPANY
TBPE REGISTRATION NO. F-2614

YOUNG PROFESSIONAL RESOURCES
8209 Roughrider Drive, Suite 101
Windcrest, TX 78239
Tel. (210) 590-9215 Fax (210)590-9346
Young Professional Resources ©
Registration No. F-8635

WATER JOB NO: 12-5096

INGRAM ROAD
CULEBRA TO MABE
WATER SYSTEM
UTILITY ADJUSTMENTS PLAN

ESTIMATED QUANTITIES			
ITEM	DESCRIPTION	UNIT	QUANTITY
100	MOBILIZATION	LS	1
101	PREPARATION OF RIGHT-OF-WAY	LS	1
550	TRENCH EXCAVATION SAFETY PROTECTION	LF	902
818	8" PVC WATERLINE (RESTRAINED)	LF	733
818	12" PVC WATERLINE (RESTRAINED)	LF	28
820	24" CONCRETE STEEL CYLINDER PIPE (C-301)	LF	83
824	RECONNECT 3/4" LONG SERVICE	EA	1
824	RELAY 2" SHORT SERVICE (AIR RELEASE)	EA	1
826	VALVE BOX ADJUSTMENT	EA	11
832	24" x 8" TAPPING SLEEVE AND VALVE	EA	1
832	24" x 12" TAPPING SLEEVE AND VALVE	EA	1
834.1	FIRE HYDRANT	EA	3
834.2	TAPPED FIRE HYDRANT	EA	1
834.3	RELOCATE FIRE HYDRANT	EA	1
836	PIPE FITTINGS, ALL SIZES AND TYPES	TON	2.3
840	8" WATER TIE-INS	EA	3
840	24" WATER TIE-INS	EA	2
840	12" WATER TIE-INS	EA	1
841	HYDROSTATIC TESTING	EA	5
844	2" BLOWOFF, TEMPORARY	EA	4
844	4" BLOWOFF, TEMPORARY	EA	2
856.2	8" CARRIER PIPE	LF	20
856.2	24" CARRIER PIPE	LF	38
856.3	CASING OR LINER 24" (OPEN CUT)	LF	20
856.3	CASING OR LINER 42" (OPEN CUT)	LF	38
858	CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS	CY	26
3000	REMOVAL, TRANSPORTATION AND DISPOSAL OF AC PIPE	LF	299
1015	SERVICE LINE BREAKS LEAK REPAIRS	EA	1
1020	WATER MAIN BREAKS LEAK REPAIRS	EA	1



LOCATION MAP
NTS

PROJECT LOCATION:
INGRAM ROAD
CULEBRA TO MABE

SHEET INDEX

STATE OF TEXAS
CHRISTOPHER BOENTGES
109721
LICENSED
PROFESSIONAL ENGINEER

CHRISTOPHER BOENTGES, P.E. — DATE 10/21/2014

STATE OF TEXAS
LEONARD DALE YOUNG
61852
LICENSED
PROFESSIONAL ENGINEER

LEONARD DALE YOUNG, P.E. — DATE 10-21-14

CITY OF SAN ANTONIO

025 UNIT PRICING FORM

PROJECT NAME: Ingram Road (Culebra Road to Mabe Road)

PROJECT NO.40-00307

ALT. NO.	ITEM NO.	DESC. CODE	S.P. NO	BID ITEM DESCRIPTION	UNIT OF MEASURE	APPROX. QUANTITIES	UNIT BID PRICE	AMOUNT	ITEM SEQUENCE NO.
	308.1			DRILLED SHAFTS (48")	LF	44			
	309.1			PRECAST REINFORCED CONCRETE CULVERT (3'x3')	LF	285			
	309.1			PRECAST REINFORCED CONCRETE CULVERT (4' X 3')	LF	68			
	309.1			PRECAST REINFORCED CONCRETE CULVERT (5' X 3')	LF	52			
	309.1			PRECAST REINFORCED CONCRETE CULVERT (7' X 3')	LF	209			
	401.1			REINFORCED CONCRETE PIPE (CLASS III) (24" DIA.)	LF	1619			
	401.1			REINFORCED CONCRETE PIPE (CLASS III) (30" DIA.)	LF	276			
	401.1			REINFORCED CONCRETE PIPE (CLASS III) (36" DIA.)	LF	304			
	401.4			SAFETY END TREATMENT (TYPE I) (24" DIA)	EA	2			
	403.1			JUNCTION BOX (4' X 4' X 4')	EA	1			
	403.2			JUNCTION BOX (5' X 5' X 5')	EA	1			
	403.7			INLET TYPE I (COMPLETE) (10 FT)	EA	8			
	403.8			INLET TYPE II (COMPLETE) (10 FT)	EA	2			
	403.9			INLET EXTENSIONS (10 FT)	EA	6			
	404.1			CORRUGATED METAL PIPE	LF	2			
	407.4			CONCRETE COLLARS	CY	3			
	409.3			GRATE AND FRAME (MOD)	EA	2			
	413.1			FLOWABLE BACKFILL (LOW STRENGTH)	CY	17			
	500.1			CONCRETE CURB	LF	5097			
	502.1			CONCRETE SIDEWALKS	SY	3411			
	502.1A			CONCRETE VIA BUS BENCH FOUNDATION	EA	6			
	502.1B			CONCRETE SIDEWALKS - COMMERCIAL STRENGTH	SY	134			
	502.3			SIDEWALK DRAIN BOX (2' CLEAR OPENING)	EA	1			
	503.2			PORTLAND CEMENT CONCRETE DRIVEWAY - COMMERCIAL	SY	802			
	504.1			CONCRETE MEDIAN	SY	604			
	505.2			CONCRETE RIPRAP (5" THICK)	CY	16			
	506.1			CONCRETE RETAINING WALL- COMBINATION TYPE (<20 C.Y.)	CY	6			
	515.1			TOPSOIL	CY	550			
	516.1			BUFFALO GRASS SOLID SODDING	SY	6255			
	530.1			BARRICADES, SIGNS & TRAFFIC HANDLING	MO	12			
	531.6			R2-1 SPEED LIMIT (24"X30")(HIGH DENSITY)	EA	5			
	531.13			R3-7R RIGHT LANE MUST TURN RIGHT (30"X30")(HIGH DENSITY)	EA	2			

CITY OF SAN ANTONIO, TEXAS

GOVERNING SPECIFICATIONS, SPECIAL SPECIFICATIONS, SPECIAL PROVISIONS, AND SUPPLEMENTAL SPECIFICATIONS
FOR

INGRAM ROAD (CULEBRA ROAD TO MABE ROAD)
PROJECT NO. 40-00307

All Standard Specifications and Special Specifications applicable to this project are identified as follows:

- CITY OF SAN ANTONIO- STANDARD SPECIFICATIONS FOR CONSTRUCTION JUNE, 2008 AND SPECIAL PROVISIONS DATED MAY 2009, FEBRUARY 2010, JUNE 2010 and NOVEMBER 2013

- TEXAS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR CONSTRUCTION AND MAINTENANCE OF HIGHWAYS, STREETS, AND BRIDGES (JUNE 1, 2004)

- SAN ANTONIO WATER SYSTEM - STANDARD SPECIFICATIONS FOR WATER AND SANITARY SEWER CONSTRUCTION (JUNE 2009 or latest revisions and additions)

ITEM		DESCRIPTION
100	-	MOBILIZATION
101	-	PREPARING RIGHT-OF-WAY
103	-	REMOVE CONCRETE
104	-	STREET EXCAVATION
105	-	CHANNEL EXCAVATION
106	-	BOX CULVERT EXCAVATION & BACKFILLING
107	-	EMBANKMENT
108	-	LIME TREATED SUBGRADE
202	-	PRIME COAT
203	-	TACK COAT

205 - HOT MIX ASPHALTIC CONCRETE PAVEMENT

208 - SALVAGING, HAULING AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT

209 - CONCRETE PAVEMENT

210 - ROLLING

220 - BLADING

300 - CONCRETE

301 - REINFORCING STEEL

302 - METAL FOR STRUCTURES

303 - WELDED WIRE FLATSHEETS

306 - STRUCTURAL EXCAVATION

307 - CONCRETE STRUCTURES

308 - DRILLED SHAFTS AND UNDER-REAMED FOUNDATIONS

309 - PRECAST REINFORCED CONCRETE BOX CULVERTS

311 - CONCRETE SURFACE FINISH

400 - EXCAVATION, TRANCHING & BACKFILLING

401 - REINFORCED CONCRETE PIPE

403 - STORM SEWER JUNCTION BOXES AND INLETS

404 - CORRUGATED METAL PIPE

407 - CONCRETE ENCASEMENT, CRADLES, SADDLES, AND COLLARS

409 - CAST IRON CASTINGS

410 - SUBGRADE FILLER

413 - FLOWABLE FILL

500 - CONCRETE CURB, GUTTER, AND CONCRETE CURB AND GUTTER

502 - CONCRETE SIDEWALKS

503 - ASPHALTIC CONCRETE, PORTLAND CEMENT CONCRETE, AND GRAVEL DRIVEWAYS

504 - CONCRETE MEDIANS AND ISLANDS

505 - CONCRETE RIPRAP

506 - CONCRETE RETAINING WALLS – COMBINATION TYPE

511 - CUTTING & REPLACING PAVEMENTS (TRENCH REPAIR)

512 - ADJUSTING EXISTING MANHOLES & VALVE BOXES

514 - PAINT & PAINTING

515 - TOPSOIL

516 - SODDING

530 - BARRICADES, SIGNS, AND TRAFFIC HANDLING

531 - SIGNS

535 - HOT APPLIED THERMOPLASTIC PAVEMENT MARKINGS

537 - RAISED PAVEMENT MARKERS

540 - TEMPORARY EROSION, SEDIMENTATION AND WATER POLLUTION PREVENTION AND CONTROL

550 - TRENCH EXCAVATION SAFETY PROTECTION

556 - CAST IN PLACE DETECTABLE WARNING SURFACE TILES

600 - TRAFFIC SIGNAL GENERAL CONDITIONS

615 - TRAFFIC SIGNAL CONTROLLER CABINET

618 - CONDUIT

620 - ELECTRICAL CONDUCTORS

624 - GROUND BOXES

628 - ELECTRICAL SERVICES

633 - BATTERY BACKUP SYSTEM FOR TRAFFIC SIGNAL

655 - CONTROLLER FOUNDATION AND PEDESTAL POSTS

656 - FOUNDATIONS FOR TRAFFIC CONTROL DEVICES

680 - INSTALLATION OF HIGHWAY TRAFFIC SIGNALS

682 - VEHICLE AND PEDESTRIAN SIGNAL HEADS

683 - LED COUNTDOWN PEDESTRIAN SIGNAL MODULE

684 - TRAFFIC SIGNAL CABLES

686 - TRAFFIC SIGNAL POLE ASSEMBLIES (STEEL)

687 - PEDESTAL POLE ASSEMBLIES

688 - PEDESTRIAN DETECTORS AND VEHICLE LOOP DETECTORS

693 - INTERNALLY LIGHTED STREET NAME SIGN ASSEMBLIES

694 - VIDEO IMAGING VEHICLE DETENTION SYSTEM

695 - EMERGENCY VEHICLE TRAFFIC SIGNAL PRIORITY CONTROL SYSTEM

1000 - WEB PORTAL

SPECIAL PROVISIONS FOR CONSTRUCTION

401 - REINFORCED CONCRETE PIPE (MAY 2009)

403 - STORM SEWER JUNCTION BOXES AND INLETS (MAY 2009)

502 - CONCRETE SIDEWALKS (MAY 2009)

503 - ASPHALTIC CONCRETE, PORTLAND CEMENT CONCRETE, AND GRAVEL DRIVEWAYS (MAY 2009)

505 - CONCRETE RIPRAP (MAY 2009)

526 - FIELD OFFICE (JUNE 2010)

700 - PROJECT SCHEDULES (FEBRUARY 2010)

804 - NEW TREE & SHRUB PLANTING & MAINTENANCE (NOVEMBER 2013)

BID ITEM SUMMARY REVISIONS (MAY 2009)

SUPPLEMENTAL SPECIFICATIONS FOR CONSTRUCTION

SUP 1 - ETHERNET SWITCH

SUP 2 - WIRELESS ACCESS POINT

SPECIAL SPECIFICATIONS FOR CONSTRUCTION

696 - RADAR DETECTION DEVICE

801 - TREE AND LANDSCAPE PROTECTION

802 - TREE PRUNING, SOIL AMENDING AND FERTILIZATION

SPECIAL DETAILS FOR CONSTRUCTION

PROJECT SIGN DETAIL

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) STANDARD SPECIFICATIONS FOR CONSTRUCTION

164 - SEEDING FOR EROSION CONTROL

168 - VEGETATIVE WATERING

400 - EXCAVATION AND BACKFILL FOR STRUCTURES

420 - CONCRETE STRUCTURES

450 - RAILING

465 - MANHOLES AND INLETS

466 - HEADWALLS AND WINGWALLS

508 - CONSTRUCTING DETOURS

512 - PORTABLE CONCRETE TRAFFIC BARRIER

529 - CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER

662 - WORK ZONE PAVEMENT MARKINGS

677 - ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS

681 - TEMPORARY TRAFFIC SIGNALS

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) SPECIAL SPECIFICATIONS FOR CONSTRUCTION

5049 - BIODEGRADABLE EROSION CONTROL LOGS

6834 - PORTABLE CHANGEABLE MESSAGE SIGN

TEXAS DEPARTMENT OF TRANSPORTATION (TXDOT) SPECIAL PROVISIONS FOR CONSTRUCTION

6834-001 - PORTABLE CHANGEABLE MESSAGE SIGN

6834-002 - PORTABLE CHANGEABLE MESSAGE SIGN

SAN ANTONIO WATER SYSTEM
STANDARD SPECIFICATIONS FOR CONSTRUCTION

100 - MOBILIZATION

101 - PREPARATION OF RIGHT-OF-WAY

550 - TRENCH EXCAVATION SAFETY PROTECTION

812 - WATER MAIN INSTALLATION

818 - PVC (C-900) PIPE INSTALLATION

820 - CONCRETE STEEL CYLINDER PIPE INSTALLATION

824 - SERVICE SUPPLY LINES

826 - VALVE BOX ADJUSTMENT

832 - TAPPING SLEEVES AND VALVES

834 - FIRE HYDRANTS

836 - GREY-IRON AND DUCTILE-IRON FITTINGS

839 - ANCHORAGE/THRUST BLOCKING & JOINT RESTRAINT

840 - WATER TIE-INS

841 - HYDROSTATIC TESTING OPERATIONS

844 - BLOW-OFF ASSEMBLIES

848 - SANITARY SEWERS

852 - SEWER MANHOLES

856 - JACKING, BORING OR TUNNELING PIPE

858 - CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS

864 - BYPASS PUMPING

866 - SEWER MAIN TELEVISION INSPECTION

1015 - SERVICE LINE BREAKS/LEAK REPAIRS

1020 - WATER MAIN BREAKS/LEAK REPAIRS

SAN ANTONIO WATER SYSTEM
SPECIAL SPECIFICATIONS FOR CONSTRUCTION

3000 - HANDLING ASBESTOS CEMENT PIPE

ESTIMATED QUANTITIES

CITY OF SAN ANTONIO			TOTAL
UNIT NO.	BID ITEM DESCRIPTION	UNIT	QUANTITIES
100.1	MOBILIZATION	LS	1
100.2	INSURANCE & BOND	LS	1
101.1	PREPARING OF RIGHT OF WAY	LS	1
103.1	REMOVE CONCRETE CURB (700 LF < X > 10,000 LF)	LF	1954
103.3	REMOVE CONCRETE SIDEWALKS & DRIVEWAYS (>10,000 S.F.)	SF	19645
103.4	REMOVE MISCELLANEOUS CONCRETE	SF	4518
104.1	STREET EXCAVATION	CY	13325
105.1	CHANNEL EXCAVATION / DRAIN	CY	335
106.1	BOX CULVERT EXCAVATION AND BACKFILL	CY	486
107.1	EMBANKMENT (FINAL) (DENS CONT) (TY A)	CY	485
107.1	EMBANKMENT (FINAL) (DENS CONT) (TY B)	CY	50
108.1	LIME TREATED SUBGRADE (6" COMPACTED DEPTH)	SY	20662
108.2	LIME	TON	294
202.1	PRIME COAT	GAL	4133
203.1	TACK COAT	GAL	4085
205.2	HOT MIX ASPHALTIC PAVEMENT TYPE B (10" DEPTH)	SY	20662
205.3	HOT MIX ASPHALTIC PAVEMENT TYPE C (2" DEPTH)	SY	18250
205.4	HOT MIX ASPHALTIC PAVEMENT TYPE D (2" DEPTH)	SY	23241
208.1	SALVAGING, HAULING AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (2" DEPTH)	SY	5204
209.2	CONCRETE PAVEMENT (10" DEEP) (BUS PAD)	SY	1480
307.1	CONCRETE-HEADWALLS	CY	23
307.1	CONCRETE-CHANNEL (DOWNSTREAM)	CY	30
307.1	CONCRETE-CATCH BASIN (UPSTREAM)	CY	22
308.1	DRILLED SHAFTS (24")	LF	53
308.1	DRILLED SHAFTS (36")	LF	67
308.1	DRILLED SHAFTS (48")	LF	44
309.1	PRECAST REINFORCED CONCRETE CULVERT (3' X 3')	LF	285
309.1	PRECAST REINFORCED CONCRETE CULVERT (4' X 3')	LF	68
309.1	PRECAST REINFORCED CONCRETE CULVERT (5' X 3')	LF	52
309.1	PRECAST REINFORCED CONCRETE CULVERT (7' X 3')	LF	209
401.1	REINFORCED CONCRETE PIPE (CLASS III) (24" DIA.)	LF	1619
401.1	REINFORCED CONCRETE PIPE (CLASS III) (30" DIA.)	LF	276
401.1	REINFORCED CONCRETE PIPE (CLASS III) (36" DIA.)	LF	304
401.4	SAFETY END TREATMENT (TYPE I) (24" DIA)	EA	2
403.1	JUNCTION BOX (4' X 4' X 4')	EA	1
403.2	JUNCTION BOX (5' X 5' X 5')	EA	1
403.7	INLET TYPE I (COMPLETE) (10 FT)	EA	8
403.8	INLET TYPE II (COMPLETE) (10 FT)	EA	2
403.9	INLET EXTENSIONS (10 FT)	EA	6
404.1	CORRUGATED METAL PIPE	LF	2
407.4	CONCRETE COLLARS	CY	3
409.3	GRATE AND FRAME (MOD)	EA	2
413.1	FLOWABLE BACKFILL (LOW STRENGTH)	CY	17

500.1	CONCRETE CURB	LF	5097
502.1	CONCRETE SIDEWALKS	SY	3411
502.1A	CONCRETE VIA BUS BENCH FOUNDATION	EA	6
502.1B	CONCRETE SIDEWALKS - COMMERCIAL STRENGTH	SY	134
502.3	SIDEWALK DRAIN BOX (2' CLEAR OPENING)	EA	1
503.2	PORTLAND CEMENT CONCRETE DRIVEWAY - COMMERCIAL	SY	802
504.1	CONCRETE MEDIAN	SY	604
505.2	CONCRETE RIPRAP (5" THICK)	CY	16
506.1	CONCRETE RETAINING WALL- COMBINATION TYPE (<20 C.Y.)	CY	6
515.1	TOPSOIL	CY	550
516.1	BUFFALO GRASS SOLID SODDING	SY	6255
530.1	BARRICADES, SIGNS & TRAFFIC HANDLING	MO	14
531.6	R2-1 SPEED LIMIT (24"X30")(HIGH DENSITY)	EA	5
531.13	R3-7R RIGHT LANE MUST TURN RIGHT (30"X30")(HIGH DENSITY)	EA	2
531.14	R3-8 LANE USE CONTROL (30"X30")	EA	2
531.17	R4-7 KEEP RIGHT (24"X30")(HIGH DENSITY)	EA	2
531.68	R3-17 (BIKE LANE)(30"X24")	EA	8
531.70	R3-17b (ENDS)(30"x12")	EA	2
531.71	R4-4 (BEGIN RIGHT TURN LANE YIELD TO BIKES)(36"X30")(HIGH DENSITY)	EA	1
531.XX	R10-17-SA LEFT TURN YIELD ON FLASHING ARROW (30"X30")	EA	2
535.1	4" WIDE YELLOW LINE	LF	9906
535.2	4" WIDE WHITE LINE	LF	1505
535.4	8" WIDE WHITE LINE	LF	4786
535.7	24" WIDE WHITE LINE	LF	1514
535.8	RIGHT WHITE ARROW	EA	5
535.9	LEFT WHITE ARROW	EA	12
535.12	WORD "ONLY"	EA	7
535.16	STRAIGHT WHITE ARROW BICYCLE FACILITY	EA	7
535.17	BIKE RIDER SYMBOL	EA	7
535.X	24" WIDE YELLOW LINE	LF	374
535.X	MEDIAN NOSE (YELLOW)	EA	2
537.6	TRAFFIC BUTTON (TYPE I-C)	EA	229
537.8	TRAFFIC BUTTON (TYPE II A-A)	EA	356
540.1	ROCK FILTER DAMS (INSTALL/REMOVE) (TYPE 3)	LF	30
540.6	CONSTRUCTION EXITS (INSTALL/REMOVE)	SY	225
540.9	TEMPORARY SEDIMENT CONTROL FENCE	LF	4457
540.10	CURB INLET GRAVEL FILTERS	LF	335
550.1	TRENCH EXCAVATION SAFETY PROTECTION	LF	193
615.1	TRAFFIC SIGNAL CONTROLLER ASSEMBLY (TYPE 332 CABINET)	EA	1
618.1	CONDUIT TRENCHED 2 INCH PVC (SCHEDULE 40)	LF	172
618.2	CONDUIT TRENCHED 3 INCH PVC (SCHEDULE 40)	LF	215
618.5	CONDUIT 3 INCH PVC (SCHEDULE 40) (BORE)	LF	840

NO.	REVISION	DRAWN	APPROVED	DATE

Lockwood, Andrews & Newnam, Inc.
A LEO A. DALY COMPANY
TBPE REGISTRATION NO. F-2614

CITY OF SAN ANTONIO
TRANSPORTATION AND CAPITAL IMPROVEMENTS

INGRAM RD. RECONSTRUCTION

RECONSTRUCTION QUANTITIES

100% SUBMITTAL	PROJECT NO.: 40-00307		DATE: 9/19/14
DRAWN BY:	DSGN. BY:	CHKD. BY:	SHEET NO.: 22

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TXDOT UNIT NO.	BID ITEM DESCRIPTION	UNIT	TOTAL QUANTITIES
164 2009	BROADCAST SEED (TEMP)(WARM)	SY	3000
164 2011	BROADCAST SEED (TEMP)(COOL)	SY	3000
168 2001	VEGETATIVE WATERING	MG	95
400 2006	CUT & RESTORING PAV	SY	35
420 2019	CL C CONC (CAP)	CY	1
450 2064	RAIL (TY C221)	LF	320
450 2077	RAIL (HAND RAIL) (TY F)	LF	169
465 2190	INLET (COMPLETE) (DROP) (TY W-1)	EA	2
465 XXXX	INLET (COMPLETE) (TRAFFIC) (TY-W3)	EA	2
466 2006	WINGWALL (SW-0) (HW=4 FT)	EA	1
508 2002	CONSTRUCTING DETOURS	SY	2913
512 2008	PORT CTB (FUR & INST) (LOW PROF) (TY 1)	LF	1740
512 2009	PORT CTB (FUR & INST) (LOW PROF) (TY 2)	LF	160
512 2026	PORT CTB (MOVE) (LOW PROF) (TY 1)	LF	2120
512 2027	PORT CTB (MOVE) (LOW PROF) (TY 2)	LF	220
512 2044	PORT CTB (REMOVE) (LOW PROF) (TY 1)	LF	1740
512 2045	PORT CTB (REMOVE) (LOW PROF) (TY 2)	LF	160
529 2001	CONC CURB (TY I)	LF	176
529 2064	CONC CURB (TY F1)	LF	74
529 2065	CONC CURB (TY F2)	LF	255
662 2001	WK ZN PAV MRK NON-REMOV (W) 4" (BRK)	LF	80
662 2004	WK ZN PAV MRK NON-REMOV (W) 4" (SLD)	LF	4270
662 2016	WK ZN PAV MRK NON-REMOV (W) 24" (SLD)	LF	35
662 2032	WK ZN PAV MRK NON-REMOV (Y) 4" (SLD)	LF	5107
662 2064	WK ZN PAV MRK REMOV (W) 4" (BRK)	LF	750
662 2065	WK ZN PAV MRK REMOV (W) 4" (DOT)	LF	30
662 2067	WK ZN PAV MRK REMOV (W) 4" (SLD)	LF	10082
662 2075	WK ZN PAV MRK REMOV (W) 8" (SLD)	LF	990
662 2079	WK ZN PAV MRK REMOV (W) 24" (SLD)	LF	205
662 2099	WK ZN PAV MRK REMOV (Y) 4" (SLD)	LF	19856
662 2113	WK ZN PAV MRK SHT TERM (TAB) TY W	EA	408
662 2115	WK ZN PAV MRK SHT TERM (TAB) TY Y-2	EA	316
677 2001	ELIM EXT PAV MRK & MRKS (4")	LF	3313
677 2003	ELIM EXT PAV MRK & MRKS (8")	LF	559
677 2007	ELIM EXT PAV MRK & MRKS (24")	LF	129
677 2008	ELIM EXT PAV MRK & MRKS (ARROW)	EA	6
677 2018	ELIM EXT PAV MRK & MRKS (WORD)	EA	3
681 2001	TEMP TRAF SIGNALS	EA	6
5049 2003	EROSION CONTROL LOG (12" DIAM)	LF	192
6834 2002	PORTABLE CHANGEABLE MESSAGE SIGN	EA	4

101	PREPARING RIGHT OF WAY	LS	1
205.4	HOT MIX ASPHALTIC PAVEMENT TYPE D (2" COMPACTED DEPTH)	SY	305
206.1	ASPHALT TREATED BASE (10" COMPACTED DEPTH)	SY	239
550	TRENCH EXCAVATION SAFETY PROTECTION	LF	1015
818	8" PVC WATERLINE (RESTRAINED)	LF	733
818	12" PVC WATERLINE (RESTRAINED)	LF	28
820	24" CONCRETE STEEL CYLINDER PIPE (C-301)	LF	83
824	RECONNECT 3/4" LONG SERVICE	EA	1
824	RELAY 2" SHORT SERVICE (AIR RELEASE)	EA	1
826	VALVE BOX ADJUSTMENT	EA	11
834.1	FIRE HYDRANT	EA	3
834.2	TAPPED FIRE HYDRANT	EA	1
834.3	RELOCATE FIRE HYDRANT	EA	1
836	PIPE FITTINGS, ALL SIZES AND TYPES	TON	2.3
840	8" WATER TIE-INS	EA	3
840	12" WATER TIE-INS	EA	1
840	24" WATER TIE-INS	EA	2
841	HYDROSTATIC TESTING	EA	5
844	2" BLOWOFF, TEMPORARY	EA	4
844	4" BLOWOFF, TEMPORARY	EA	2
848	8" PVC SANITARY SEWER LINE (6'-10') SDR 26	LF	93
848	8" PVC SANITARY SEWER LINE (6'-10') SDR 26 CL 160	LF	20
852.1	SANITARY SEWER MANHOLE (0'-6')	EA	3
852.3	EXTRA DEPTH MANHOLES (>6')	VF	9
856.2	8" CARRIER PIPE	LF	20
856.2	24" CARRIER PIPE	LF	38
856.3	CASING OR LINER 24" (OPEN CUT)	LF	20
856.3	CASING OR LINER 42" (OPEN CUT)	LF	38
858	CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS	CY	28
864	BYPASS PUMPING	LS	1
866	SEWER MAIN TELEVISION INSPECTION (8"-15")	LF	743
1015	SERVICE LINE BREAKS LEAK REPAIRS	EA	1
1020	WATER MAIN BREAKS LEAK REPAIRS	EA	1
3000	REMOVAL, TRANSPORTATION AND DISPOSAL OF AC PIPE	LF	299

NO.	REVISION	DRAWN	APPROVED	DATE

Lockwood, Andrews & Newnam, Inc.
A LEO A. DALY COMPANY
TBPE REGISTRATION NO. F-2614

CITY OF SAN ANTONIO
TRANSPORTATION AND CAPITAL IMPROVEMENTS

INGRAM RD. RECONSTRUCTION

RECONSTRUCTION QUANTITIES

100% SUBMITTAL	PROJECT NO.: 40-00307	DATE: 9/19/14
DRAWN BY:	DSGN. BY:	CHKD. BY:	SHEET NO.: 24

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Geotechnical Engineering Study

Ingram Road
from Culebra Road to 500-ft east of Mabe Road
San Antonio, Texas

Arias Job No. 2012-985

ARIAS & ASSOCIATES
Geotechnical • Environmental • Testing

Prepared For:

Lockwood, Andrews & Newman, Inc.

July 22, 2013

ARIAS & ASSOCIATES
Geotechnical • Environmental • Testing

July 22, 2013
Arias Job No. 2012-985

Jeremy S. Doege, PE
Lockwood, Andrews & Newman, Inc.
10101 Reunion Place, Suite 200
San Antonio, Texas 78216-4165

RE: Geotechnical Engineering Study
Ingram Road – from Culebra Road to 500-ft east of Mabe Road
San Antonio, Texas

Dear Mr. Doege:

Arias & Associates, Inc. (Arias) is pleased to submit this Geotechnical Report with the results of our Pavement Engineering Study for the proposed improvements of Ingram Road from Culebra Road to 500 feet east of Mabe Road in San Antonio, Texas. This project was performed in general accordance with a Master Agreement between Lockwood, Andrews & Newman, Inc. and Arias & Associates, Inc. (Arias), dated March 6, 2013, and was authorized by Work Authorization No. 160-10613-000-901, dated May 9, 2013.

The purpose of this geotechnical engineering study was to establish pavement and culvert engineering properties of the subsurface soil and groundwater conditions present at the site. The scope of the study is to provide geotechnical engineering criteria for use by design engineers in preparing the pavement and culvert designs. Our findings and recommendations should be incorporated into the design and construction documents for the proposed development.

The long-term success of the project will be affected by the quality of materials used for construction and the adherence of the construction to the project plans and specifications. The quality of construction can be evaluated by implementing Quality Assurance (QA) testing. As the Geotechnical Engineer of Record (GER), we recommend that the earthwork, pavement and culvert construction be tested and observed by Arias in accordance with the report recommendations. A summary of our qualifications to provide QA testing is discussed in the "Quality Assurance Testing" section of this report. Furthermore, a message to the Owner with regard to QA testing is provided in the ASFE publication included in Appendix F.

We appreciate the opportunity to serve you during this phase of design. If we may be of further service, please call.

Sincerely,
Arias & Associates, Inc.
TBPE Registration No: F-32

STATE OF TEXAS
RENE P. GONZALES
86259
LICENSED PROFESSIONAL ENGINEER
7/22/13

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INTRODUCTION

The results of our Geotechnical Engineering Study for the proposed Ingram Road reconstruction project (from Culebra Road to 500-ft east of Mabe Road) in San Antonio, Texas are presented in this Geotechnical Report. This study was performed in general accordance with a Master Agreement between Lockwood, Andrews & Newman, Inc. (LAN) and Arias & Associates, Inc. (Arias), dated March 6, 2013, and was authorized by Work Authorization No. 160-10613-000-901, dated May 9, 2013.

SCOPE OF SERVICES

The purpose of this geotechnical engineering study was to conduct subsurface exploration and laboratory testing to establish the engineering properties of the subsurface materials present on the project site. This information was used to develop the geotechnical engineering criteria for use by design engineers to aid in preparing the pavement and culvert designs. Environmental, slope stability, pavement drainage, utility engineering studies of any kind were not a part of our authorized scope of services for this project.

PROJECT AND SITE DESCRIPTION

It is understood that the project involves removal and replacement of the site pavements along Ingram Road. Construction will include reconstruction of the roadway with new curbs and sidewalks. We understand that a multiple-box culvert (MBC) bridge crossing will likely be provided over an existing drainage feature located along the project.

We have performed a pavement analysis and developed pavement design sections for a Secondary Arterial Roadway, as defined by the City of San Antonio (CoSA) functional classification system description. This report includes our design pavement section options, and pavement and MBC design and construction considerations.

At the time of our subsurface exploration, the existing pavements were in a generally fair condition with un-improved shoulders. A Vicinity Map and Site Photographs are included in Appendix A.

SOIL BORINGS AND LABORATORY TESTING

Seven (7) soil borings were drilled at the approximate locations shown on the Boring Location Plan included as Figure 2 in Appendix A. The borings were generally drilled to depths of about 10 to 25 feet below the existing ground surface at the time of the geotechnical exploration conducted on June 6, 2013. Drilling was performed in general accordance with ASTM D 1587 and ASTM D 1586 for thin-walled tube and Split Spoon sampling techniques, respectively, as described in Appendix C. A truck-mounted drill rig using continuous flight augers together with the sampling tools noted were used to secure the subsurface soil samples. After completion of drilling, the boreholes were backfilled with

soil cuttings to 3 feet below the street surface and then grouted, and patched in accordance with CoSA repair guidelines.

Samples of encountered materials were obtained by using a split-barrel sampler while performing the Standard Penetration Test (ASTM D 1586). The sample depth intervals are included on the soil boring logs included in Appendix B. Arias' field representative visually logged each recovered sample and placed a portion of the recovered sampled into a plastic bag with zipper-lock for transport to our laboratory.

Soil classifications and borehole logging were conducted during the exploration by our senior field engineering technician (logger) working under the supervision of the project Geotechnical Engineer. Final soil classifications, as seen on the attached boring logs, were determined in the laboratory based on laboratory and field test results and applicable ASTM procedures.

As a supplement to the field exploration, laboratory testing to determine soil water content, Atterberg Limits, and percent passing the US Standard No. 200 sieve was conducted. In addition, a hydrometer/sieve analyses was performed on a bulk sample taken at the planned culvert crossing to develop grain size curves for use by others in evaluating scour potential. The laboratory results are reported in the boring logs included in Appendix B. A key to the terms and symbols used on the logs is also included in Appendix B. The soil laboratory testing for this project was done in accordance applicable ASTM procedures with the specifications and definitions for these tests listed in Appendix C.

Remaining soil samples recovered from this exploration will be routinely discarded following submittal of this report.

Bulk Sample Testing

A bulk sample of the near-surface soils was obtained near the Boring B-3 location to develop a subgrade-support pavement value for use in the pavement design. Laboratory testing performed on the bulk sample included Atterberg limits, moisture-density relationship, and CBR testing. The moisture-density relationship, using the Standard Proctor (ASTM D 698) method, was performed to establish the optimum moisture content and the maximum dry density of the bulk sample when subjected to a specified compactive effort. A laboratory CBR test was performed using the three-point method. The results of the bulk sample testing are provided in Appendix D.

Lime-Series: We added various amounts of lime to samples of the recovered subgrade to determine the effect of the lime on the plasticity of the site soils. The testing provided as part of this study was provided as a general guide to assist in budgeting for the project. We recommend that the subgrade soils encountered at the time of construction be reviewed to evaluate the consistency of the subgrade conditions along the project alignment. Localized

areas with higher plasticity soils may require greater amounts of lime. The final amounts of lime required for stabilization should be verified at the time of construction to confirm the values indicated as part of this design study.

Sulfate Testing Results: Laboratory testing was conducted on a composite sample recovered from the borings drilled at the site to determine the sulfate content. Testing was performed in accordance with TxDOT test method Tex-145-E "Determining Sulfate Content in Soils." The test result indicated that the sulfate contents of the samples retrieved within approximately 2 feet of the existing ground surface are about 120 parts per million (ppm). The results are indicative of low soil sulfate content. Based on the results of the sulfate testing, lime or cement treatment of the subgrade is considered a suitable site improvement option for the project.

SUBSURFACE CONDITIONS

Geology, generalized stratigraphy, and groundwater conditions at the project site are discussed in the following sections. The subsurface and groundwater conditions are based on conditions encountered at the boring locations to the depths explored.

Geology

The earth materials underlying the project site have been regionally mapped as Fluviatile terrace deposits over clay of the Pecan Gap formation. The fluviatile terrace deposits are floodplain deposits and consist primarily of clay containing various amounts of silt, sand, and gravel. The near-surface soils encountered in the borings included gravel seams and layers, suggesting that the soils were alluvial in the upper 4 to 10-foot depth.

The Pecan Gap formation consists of hard bluish-gray calcareous clay shale and very hard bluish-gray marl in the unweathered subsurface which weathers to a tan gray buff color. Intermittent harder and softer seams and layers, as well as bentonitic zones, are common to the formation. The material was deposited in a shallow marine environment and is fossiliferous. The Pecan Gap soils are described geologically as chalk and chalky marl, and very light yellow to yellowish brown in color. The near-surface clays of the Pecan Gap typically, but not always, consists of a highly-plastic (expansive) clay.

Existing Pavement Structure

Existing asphalt and flexible base material was observed at the boring locations which were performed within the existing roadway. The subsequent Table 1 indicates the approximate asphalt and flexible base thicknesses encountered at each of the boring locations; variations should be expected away from the boring locations.

Table 1: Existing Pavement Structure

Boring No.	Approximate Asphalt Thickness (inches)	Approximate Flexible Base Thickness (inches)
B-1	9.5	6
B-2	7	4
B-4	8	--
B-5	6.75	6
B-6	24	--
B-7	11	--

Notes:

1. An aggregate base material was not observed beneath the asphalt at the Boring B-4, B-6, and B-7 locations. The thicker asphalt pavement sections observed along the project alignment suggest that the asphalt pavement sections likely include multiple lifts of asphalt with an asphaltic surface course over an asphaltic base course.
2. Boring B-3 was drilled outside of the pavement area.

Site Stratigraphy and Engineering Properties

The general stratigraphic conditions at the boring locations are summarized below in Table 2.

Table 2: Generalized Soil Conditions

Stratum	Depth, ft	Material Type	PI range PI avg.	No. 200 range No. 200 avg.	N range N avg
Pavement	0 to (0.7-2)	7" to 24" Asphalt over 0" to 6" of Base	--	--	--
I	(0.7 - 2) to (1 - 7)	FAT CLAY (CH) with varying amounts of gravel; very stiff to hard; dark brown	32-44	72-82	18-25
			38	77	21
II	(1 - 7) to (4 - 13)	SANDY LEAN CLAY (CL), LEAN CLAY (CL); stiff to hard; and CLAYEY GRAVEL with Sand (GC); medium dense to very dense; reddish brown, light tan, tan and brown	8-31	31-66	9-79
			21	53	39
III	(4 - 13) to 25	FAT CLAY (CH), LEAN CLAY (CL) with varying amounts of sand; very stiff to hard; tan, light tan, light gray, with calcareous deposits; becomes partially cemented with depth as encountered in the deeper Borings B-3 and B-4	21-42	56-97	22- **50/3"
			31	86	49+

Where: Depth - Depth from existing ground surface during geotechnical study, feet
PI - Plasticity Index, %
No. 200 - Percent passing #200 sieve, %
N - Standard Penetration Test (SPT) value, blows per foot
** - Blow counts during seating penetration

Heavy-duty excavation equipment will be required at this site, particularly to excavate very dense gravel, hard soil, and partially cemented soils.

Groundwater

A dry soil sampling method was used to obtain the soil samples at the project site. Groundwater was not observed within the soil borings during soil sampling activities which were performed on June 6, 2013. Following the drilling and sampling operations, the open boreholes were backfilled using soil cuttings generated from the drilling process.

It should be noted that water levels in open boreholes may require several hours to several days to stabilize depending on the permeability of the soils. Groundwater levels at the time of construction may differ from the observations obtained during the field exploration because perched groundwater is subject to seasonal conditions, recent rainfall, flooding,

drought or temperature affects. Leaking underground utilities can also impact subsurface water levels. Importantly, San Antonio has experienced recent extended drought conditions.

Groundwater levels should be verified immediately prior to construction. Gravels and sand soils, as well as seams of these more permeable type materials, can transmit "perched" groundwater. Granular utility backfills can provide a conduit for water to collect under roadways and can ultimately lead to pavement distress. Provisions to intercept and divert "perched" or subsurface water should be made if subsurface water conditions become problematic.

Dewatering during construction is considered means and methods and is the sole responsibility of the contractor.

Bulk Sample Testing Results

The bulk sample of near-surface clay had a liquid limit (LL) of 61 and a plasticity index (PI) of 35. The clay sample had an optimum moisture content of 25.3 percent and maximum dry unit weight of 90.3 pcf, tested in general accordance with the ASTM D 698 test procedure. At a density of 95 percent of the maximum dry density, the material had a measured soaked California Bearing Ratio (CBR) value of about 3.5. The results of the CBR and moisture density testing are presented in Appendix D.

Lime Series: We added various amounts of lime to a sample of the recovered subgrade sample to evaluate the effect of the lime on the plasticity of the site soils. Based on the results of the testing, the PI of the natural clays was reduced to a value below 20 with the addition of about 4 percent lime, by weight. The lime series test results are presented in Appendix D.

We recommend that the subgrade soils encountered at the time of construction be reviewed to evaluate the consistency of the subgrade conditions along the project alignment. Localized areas with higher plasticity soils may require greater amounts of lime. The final amounts of lime required for stabilization should be verified at the time of construction to confirm the values indicated as part of this design study.

Scour Considerations

A sieve/hydrometer analyses was performed on a representative sample of the near-surface soils taken at the planned culvert crossing to develop a soil gradation curve to aid in a scour analysis to be performed by others. The grain size distribution curve is presented in Appendix D. Our interpreted values are: $\mathbf{D_{50}}$ of 0.0026 mm and $\mathbf{D_{95}}$ of 0.8 mm. The $\mathbf{D_{95}}$ value is the diameter of the soil particle below which 95% material, by weight, of the soil sample has a smaller diameter. The $\mathbf{D_{50}}$ value is the diameter of the soil particle below which 50% material, by weight, of the soil sample has a smaller diameter.

IBC Site Classification and Seismic Design Coefficients

Section 1613 of the International Building Code (2012) requires that every structure be designed and constructed to resist the effects of earthquake motions, with the seismic design category to be determined in accordance with Section 1613 or ASCE 7. Site classification according to the International Building Code (2012) is based on the soil profile encountered to 100-foot depth. The stratigraphy at the site location was explored to a maximum 25-foot depth. Materials having similar consistency were extrapolated to be present between 25 and 100-foot depths. On the basis of the site class definitions included in the 2012 Code and the encountered generalized stratigraphy, we characterize the site as Site Class D.

Seismic design coefficients were determined using the on-line software, Seismic Hazard Curves and Uniform Response Spectra, version 5.1.0, dated February 10, 2011 accessed at (http://earthquake.usgs.gov/hazards/designmaps/javacalc.php). Analyses were performed considering the 2012 International Building Code. Input included coordinates (29.46°N, 98.636°W) and Site Class D. Seismic design parameters for the site are summarized in the following table.

Table 3: Seismic Design Parameters

Site Classification	F_a	F_v	S_s	S_1
D	1.6	2.4	0.075 g	0.027 g

Where: Fa = Site coefficient
Fv = Site coefficient
Ss = Mapped spectral response acceleration for short periods
S1 = Mapped spectral response acceleration for a 1-second period

PAVEMENT EVALUATION

Expansive Soils

The site soils beneath the planned pavements have very high expansion characteristics. Expansive clays shrink when they lose water and swell or grow in volume when they gain water content. The potential of expansive clays to shrink and swell is generally related to the Plasticity Index (PI). Clays with a higher PI typically have a greater potential for soil volume changes due to moisture content variations. Change in soil moisture is the single most important factor affecting the shrinking and swelling of clays. The most pronounced movements are commonly observed when soils are exposed to extreme moisture fluctuations that occur between drought conditions and wet seasons.

It has been our experience that with these soil types, moisture content changes (sometimes deep-seated) within the expansive clay subgrade can lead to pavement cracking and undulating pavement and curbs. The street may be properly designed and constructed with the proper section thickness and materials to accommodate the design traffic loading, but still not perform well due to expansive clay movements.

We have estimated potential vertical movement for this site using the Tex-124-E method outlined by the Texas Department of Transportation (TXDOT). The Tex-124-E method provides an estimate of potential vertical rise (PVR) using the liquid limits, plasticity indices, and existing water contents for soils. The PVR is estimated in the seasonally active zone. Using the TXDOT method, we estimated the PVR to range from 2 to 4 inches.

Estimated PVRs are based upon assumed changes in soil moisture content from a dry to a wet condition; however, soil movements in the field depend on the actual changes in moisture content. Thus, actual soil movements could be less than that calculated if little soil moisture variations occur or the actual movement could exceed the estimated values if actual soil moisture content changes exceed the assumed dry and wet limits outlined by the PVR method. Such moisture conditions that exceed the limits of the PVR method may be the result of extended droughts, flooding, perched groundwater infiltration, poor surface drainage, and/or leaking irrigation lines.

We've performed our pavement analyses for this project using the 1993 AASHTO Guide for Design of Pavement Structure. The AASHTO procedure includes provisions to account for roadbed swelling through a reduction in serviceability or ride quality over time as the roadbed swells. Based on the estimated site PVR, we estimate a loss if serviceability of about 1.2 over a 20 year service life due to expansive soil-related movement. To account for this loss in serviceability, the pavement section can be increased as per the AASHTO procedure. However, it is Arias' opinion that this increase in pavement structure will have little benefit in terms of reducing expansive soil-related pavement distress due to an estimated active zone

of about 15 feet. A more effective approach would be to reduce the potential for moisture fluctuations beneath the pavement as discussed in the subsequent report section.

Moisture Fluctuations Beneath Pavements

It is common for moisture content values to remain fairly constant in the middle of the roadway. The moisture levels in the subgrade soils located near the edge of roadways are more susceptible to changes in moisture that occur due to natural seasonal moisture fluctuations. The edges will dry and shrink during drought conditions, relative to the center of the roadway. During extremely wet climate periods, the edges will swell relative to the center of the roadway. The shrinking and swelling of subgrade soils near the edge of pavements will result in longitudinal, surface cracking that occurs parallel to the roadway. Undulating pavement and curbs could also result from these shrink/swell movements. Based on our experience, edge cracking typically occurs at a distance of 3 to 9 feet from the edge of the roadway. Edge cracking associated with soil shrinkage movements may occur at greater distances during extreme environmental conditions. The implementation of vertical moisture barriers (VMBs) can improve the long term performance of the pavement by reducing the impact of the expansive soils.

Based the results of this study, the owner can consider the option of constructing a VMB to help maintain more consistent moisture conditions beneath the pavement, thus reducing the severity of expansive soil-related distress. The VMB may consist of polyethylene plastic sheeting placed in an excavated vertical trench that is backfilled with flowable fill. We recommend that a VMB be installed at least 5-ft deep and be located at the pavement edges beneath the curb or directly behind curb. VMBs should be considered for installation along the length of the project on both sides of the street, or at least where the existing pavement is experiencing more distress. Careful coordination will be required by the installation contractor during construction to prevent from damaging existing utilities. As an alternate to installing VMBs, the owner may decide to accept more risk for expansive soil-related movement and plan for more pavement maintenance and repair; please refer to the "Performance and Maintenance Considerations" section of this Report for additional information.

Potential landscaping adjacent to the existing roadways will increase the potential for moisture fluctuations along the pavement edges. Careful consideration should be provided by the designers to provide positive drainage away from these areas. Ponding should not be allowed near the edges of the planned pavements.

Effects of Trees and Vegetation

Soil moisture can be affected by the roots of vegetation that extend beneath pavements. Trees remove large quantities of water from the soil through their root systems during the growing season and cause localized drier areas in the vicinity of the roots. The limits of affected areas are typically related to the lateral extent of a root system, which are a function

of the tree height and the spread of its branches. It is generally accepted that a root system will influence the soil moisture levels to a distance roughly equivalent to the drip line (extent of branches). Pavements constructed over a tree root system may shrink due to changes in moisture content and result in cracking. These types of movements result in concentric crack patterns in street pavements located near trees.

If trees will be located next to the roadways, the designers may wish to consider installing localized root barriers as part of the pavement construction in these areas. The root barriers may reduce the potential for future pavement distress due to soil moisture variations from tree roots. Should root barriers be considered, we recommend the designers consult with a tree expert to discuss the effect of barriers on the health of the trees.

PAVEMENT RECOMMENDATIONS

We have been informed that Ingram Road is designated as a CoSA Secondary Arterial, Type A with a 86-foot wide right-of-way (ROW). If a different street classification is to be utilized, then we should be contacted to provide additional recommendations.

Design Parameters and Traffic Conditions

At the time of this report, the plan-and-profile sheets for the roadways were not available for review. Based on the results of our field study and laboratory testing, it appears likely that the roadway subgrade will consist predominantly of high plasticity clay (CH). We obtained a bulk sample of the CH soils for laboratory testing to determine the design California Bearing Ratio (CBR). Our laboratory test results for a bulk sample taken at the Boring B-3 location indicated a CBR value of 3.5. Our review of the soil conditions encountered in the borings suggests that higher plasticity soils existing along the alignment. We selected a design CBR of 2.2 for use in our pavement design to account for the higher plasticity soils encountered in the soil borings.

It should be noted that the conditions and recommendations contained herein are based on the materials encountered at the time of field exploration. These conditions may differ if road grading (cut/fill) operations are performed. We recommend that a representative of Arias be retained to observe that our recommendations are followed and to assist in determining the actual subgrade material classification at a particular location. Furthermore, we should be given an opportunity to review the final plan-and-profile sheets to determine if changes to our recommendations are needed.

Recommendations in this section were prepared in accordance with the 1993 AASHTO Guide for Design of Pavement Structure and the CoSA CIMS DGM. Structural material coefficients are provided subsequently in Table 4, and design parameters utilized in our pavement evaluation are presented subsequently in Table 5.

Table 4: Material Coefficients

Material	Structural Coefficient
Hot Mix Asphaltic Concrete – Type "C" Surface Course	0.44
Hot Mix Asphaltic Concrete – Type "B" Base Course	0.38
Flexible Base Course – TxDOT Item 247, Type A, Grades 1 or 2	0.14
6-inch Lime-Treated Depth	0.48

Table 5: Pavement Design Parameters

Design Parameters	Secondary Arterial	
	Flexible Pavement	Rigid Pavement
Reliability Factor	95%	95%
Overall Standard Deviation	0.45	0.35
Initial Serviceability Index	4.2	4.5
Terminal Serviceability Index	2.5	2.5
18-kip Equivalent Axle Loads (ESALs)	3,000,000	4,500,000

Flexible Pavement Recommendations for Secondary Arterial Street

Based on the parameters provided in the previous tables, a subgrade design CBR=2.2 and the CoSA CIMS DGM, a structural number, SN, of 5.76 was attained for flexible pavement (Secondary Arterial). The SN of 5.76 is equivalent to the maximum SN value recommended by the CoSA CIMS DGM. Our proposed design sections provided in this report were based on a SN of 5.76.

The following pavement thickness options may be considered in order to meet the design requirements for a Secondary Arterial. Many other choices or alternatives are possible.

Table 6: Flexible Pavement Options for Secondary Arterial

Subgrade Classification	High Plasticity CLAY (CH) Subgrade		
Subgrade Design CBR	CBR=2.2		
Required Structural No.	5.76 (CoSA Maximum)		
Recommended Subgrade Treatment	Hydrated Lime		
Pavement Section Options			
	Option 1	**Option 2**	**Option 3**
Type “C” or “D” HMAC Surface Course	6”	3”	3.5”
Type “B” HMAC Base Course	-	6”	10”
Type “A” Flex Base Course (Crushed Limestone)	19”	12”	-
Lime Treated Subgrade	6”	6”	6”
Calculated Structural No.	**5.78**	**5.76**	**5.82**

Rigid Pavement Recommendations for Arterial Streets

Based on the AASHTO design parameters provided in the previous tables and the existing subgrade conditions, a pavement thickness of 9.5 inches was attained for a rigid pavement section (Secondary Arterial Street). This number is between the minimum and maximum pavement thickness values noted in the CoSA CIMS DGM. Therefore, the use of **9.5 inches** of concrete is recommended for the rigid pavement section for Research Plaza.

We understand that the planned roadway will likely be subject to high truck traffic. Based on the CoSA CIMS DGM, subbase layers are recommended for higher traffic volume roadways. It is important to note that the rigid pavement design thickness provided in this study is based on the use of a subbase layer (i.e., an effective k-value of 300 pci was utilized for the design).

Table 7: Rigid Pavement Recommendations for Secondary Arterial

Subgrade Classification	High Plasticity CLAY (PI>20)	
Required Pavement Section Thickness (minimum)	9.5 inches	
Recommended Subgrade Treatment	Moisture Conditioning	
Recommended Rigid Pavement Sections		
	Option 4	**Option 5**
Concrete Pavement Thickness	9.5”	9.5”
Type “B” Base Course	--	4”
Asphaltic Concrete Bond Breaker	1”	--
Cemented Treated Base Course	6”	--
Lime Treated Subgrade	6”	6”

Notes:

1. A 1-inch asphaltic concrete bond breaker should be placed over the cement treated base course.
2. Concrete to have a 28-day Modulus of Rupture of 600 psi and a 28-day Elastic Modulus of 4,000,000 psi.

Due to the low anticipated design speeds, Arias considers it appropriate to consider both Jointed Concrete Pavements (JCP) and Continuously Reinforced Concrete Pavements (CRCP) for use in the site pavements. The JCP pavements are anticipated to require more maintenance related to the joints than CRCP pavements.

Arias recommends that the dowel sizes and embedment depths for the transverse contraction joints and the longitudinal construction joints for JCP be designed in accordance with the TxDOT concrete pavement standards presented on CPCD-94. We recommend the use of the TxDOT detail: CPCD-94, Concrete Pavement Details, Contraction Design (CPCD). We recommend CRCP include distributed reinforcing steel (No. 4 rebar @ 18-inch spacing each way, placed D/3 form the top of the slab) to account for the expansive clay soils. The distributed steel should not be continued through the pavement joints to allow the joints to function properly.

We recommend that the longitudinal and transverse steel for use in CRCP be sized by the designers to meet the minimum requirements presented on the TxDOT design standards presented on CRCP-11. We recommend the use of the TxDOT detail: CRCP (1)-03, Continuously Reinforced Concrete Pavement, One-Layer Steel Bar Placement.

Site Drainage

The favorable performance of any pavement structure is dependent on positive site drainage. This is particularly important at this site due to the expansive soils encountered in the

borings. Careful consideration should be provided by the designers to ensure positive drainage of all storm waters away from the planned pavements. Ponding should not be allowed either on or along the edges of the pavements.

Performance and Maintenance Considerations

Our pavement recommendations have been developed to provide an adequate structural thickness to support the anticipated traffic volumes. Shrink/swell movements due to moisture variations in the underlying soils should be anticipated over the life of the pavements. The owner should recognize that over a period of time, pavements may crack and undergo some deterioration and loss of serviceability. Deterioration can occur more rapidly as a result of climatic extremes such as drought conditions, or periods that are wetter than normal. We recommend the project budgets include an allowance for maintenance such as patching of cracks, repairing potholes and other distressed areas, or occasional overlays over the life of the pavement.

It has been our experience that pavement cracking will provide a path for surface runoff to infiltrate through the pavements and into the subgrade. Once moisture is allowed into the subgrade, the potential for pavement failures and potholes will increase. We recommend the owners implement a routine maintenance program with regular site inspections to monitor the performance of the site pavements. Cracking that may occur on the asphalt surface due to shrink/swell movements should be sealed immediately using a modified polymer hot-applied asphalt based sealant.

Additional crack sealing will likely be required over the design life of the pavements. Crack sealing is a proven, routine, maintenance practice successfully used by TxDOT, and other government agencies to preserve pavements and reduce accelerated wear and deterioration. Failure to provide routine crack-sealing will increase the potential for pavement failures and potholes to develop.

MULTIPLE BOX CULVERT STRUCTURE

We understand that a culvert bridge system will be used to upgrade a roadway crossing located over an existing drainage feature. Excavations for culverts should preferably be neat-excavated. The excavation may need to be over-excavated to allow for the placement of bedding material that may be required by the project civil engineer. The anticipated bearing depth of the planned culvert is not known. Based on the results of our borings, Table 8 presented subsequently outlines the allowable bearing pressures for the strata encountered at this site.

Table 8: Box Culvert Allowable Bearing Pressure Information

Stratum	Description	Allowable Bearing Pressure, psf
I	FAT CLAY (CH) with varying amounts of gravel; very stiff to hard; dark brown	1,500
II	SANDY LEAN CLAY (CL), LEAN CLAY (CL); stiff to hard; and CLAYEY GRAVEL with Sand (GC); medium dense to very dense; reddish brown, light tan, tan and brown	3,000
III	FAT CLAY (CH), LEAN CLAY (CL) with varying amounts of sand; very stiff to hard; tan, light tan, light gray, with calcareous deposits; becomes partially cemented with depth as encountered in the deeper Borings B-3 and B-4	4,000

It should be noted that the shallower the culvert is placed, the more potential for vertical movement there is associated with the expansive clays found at this project. Thus, from a potential vertical movement standpoint, it is advantageous to place the box culverts as deep as possible, while staying above any known groundwater. Heavy-duty excavation equipment will be required at this site, particularly to excavate very dense gravel, hard soil, and partially cemented soils.

Depending on seasonal weather conditions, excavations may encounter free groundwater. Groundwater was not observed during the sampling activities but may be present in the gravelly layers observed in the soil boring. If groundwater is encountered, depending on the volume, conventional sump and pump methods may be utilized to temporarily dewater the base of the excavation to remain sufficiently dry to allow for concrete placement. Alternately, a more permanent dewatering technique such as the French Drain or Strip Drain system noted above could be utilized. *The means and methods for dewatering the site are solely the responsibility of the contractor.*

Excavation equipment may disturb the bearing soils and loose pockets can occur at the culvert's bearing elevation. Accordingly, we recommend that the upper 6 inches of the base of the excavations be compacted to achieve a density of at least 95 percent of the maximum dry density as determined by TEX 114-E. Using the net allowable bearing pressures provided in Table 8 and assuming that the embedment material and soil backfill is placed and compacted as recommended below, settlement of the culvert system should be less than one (1) inch.

A common bedding and embedment material for culverts consists of 1-inch clean TXDOT concrete gravel Grade #5 (ASTM C-33 #67). Soil backfill above bedding materials and on

top of the culverts (below the bridge slab) should consist of select fill material meeting the following criteria: (1) free and clean of organic or other deleterious material, (2) have a plasticity index (PI) between 7 and 20, and (3) do not contain particles exceeding 3 inches in maximum dimension. A filter fabric should be provided between any free-draining gravel and soil backfill to aid in preventing finer-grained soils from infiltrating into the free-draining gravel, which could lead to ground loss and distress to the overlying bridge slab. Onsite soils, bedding and embedment materials, and select fill should be placed in lifts not to exceed 8 inches in loose measure and should be moisture conditioned to between -1 and +3 percentage points of optimum moisture content, and compacted to at least 95 percent of the maximum dry density determined by TEX 114-E. A representative of Arias should observe the backfill and compaction processes.

Lateral earth pressures that may act on buried culverts and/or against stem walls or wing walls can be evaluated by using the following equivalent fluid densities (EFDs) provided in Table 9 for the corresponding type of backfill. The equivalent fluid densities are based on "at-rest" earth pressure conditions.

Table 9: Lateral Earth Pressures

Wall Backfill Type	Estimated Total Soil Unit Weight, (pcf)	Effective Soil Unit Weight, (pcf)	At-Rest Earth Pressure Coefficient, (k_o)	EFD - Dry Condition, (pcf)	EFD - Submerged Condition, (pcf)
Select Fill (7≤PI≤20)	125	63	0.50	63	94
Clean Gravel	125	63	0.44	55	90
On-site Clay Soils	120	58	0.76	92	107

Notes:

1. The above equivalent fluid densities do not consider surcharge loads. A sloping ground surface behind the wall will act as a surcharge load and should be considered in the wall design.
2. Soil and hydrostatic water pressures behind walls will impose a triangular stress distribution on the walls; surcharge loads will impose a rectangular stress distribution on the walls.
3. We do not recommend the use of clay soils having a PI greater than 20 as backfill behind retaining walls. Clay soils can exert high pressures on the wall as noted above. Furthermore, clay soils can exert swelling forces/pressures significantly greater than those calculated using the EFD values. Swelling forces can result in excessive wall movement and/or distress.

The "EFD - submerged condition" values in the above table should be used if there is a chance for hydrostatic forces to develop; otherwise, the "EFD – dry condition values" can be used. However, we highly recommend that a wall drainage system (e.g. wall drain within free-draining backfill that is wrapped in filter fabric) be designed to prevent hydrostatic conditions from developing behind structural soil-retaining walls. If free-draining backfill is provided behind the wall, we recommend that a positive slope grade coupled with concrete surface

paving, or the use of a clay cap, be provided to help reduce the chances for surface water infiltration behind the wall. Furthermore, backflow prevention should be provided for any weep holes if there is a chance that the weep holes could be inundated during flooding.

Surcharge loads including equipment loads, traffic, sloping ground behind the wall, and soil stockpiles should also be considered in the analysis of the culvert or wall.

Measures should be taken to design against buoyancy forces. Some methods to help protect against buoyancy associated with water flowing in the streambed should be considered. These methods may include reducing the potential for water to migrate beneath and around the sides of the culvert. The use of stem and/or wing walls, rirprap and appropriate erosion control methods can be considered. The weight of the culvert, effective weight of soil backfill, and overlying bridge structure will also aid in resisting potential buoyancy forces.

For calculating the factor of safety against potential sliding due to the lateral pressure acting on structural retaining walls, the ultimate resistance parameters provided below may be used for the friction along the footing base. If additional lateral resistance is required, a shear key may be considered below the retaining wall footings. Recommended geotechnical design criteria are provided below.

- Bearing soils for planned wall footings may vary from fat clays to sandy lean clays depending on the anticipated bearing depth. The recommended allowable bearing pressures presented in Table 8, may be used to size potential footings for planned retaining wall structures.

- The retaining wall should be designed such that the resultant forces acts in the middle third of the footing.

- The sliding resistance along the base of the footing per lineal foot of wall can be calculated by multiplying a sliding resistant factor of 0.30 times the minimum sustained dead load bearing pressure acting on the footing.

- In addition to the sliding resistance along the base of the footing, an ultimate passive pressure of 1,000 pounds per square foot (psf) per linear foot of wall can be used only for the shear key (i.e. not for the side of the footing) to resist lateral pressures on the wall.

Global Stability Analysis

The geotechnical design criteria provided in this report are intended to assist the structural engineer in developing a design for proposed buried culverts and/or for stem walls, headwalls, and/or wing walls. The design of the retaining wall should provide a factor of safety against sliding of at least 1.5, and a factor of safety against overturning of at least 2.0.

As prescribed by CoSA special inspection requirements, the final design for all structural retaining walls greater than 4-feet in height should include a global stability analysis (GSA). Walls supporting surcharge load conditions, such as roadways, may also require a GSA to meet CoSA permit/inspection requirements.

Our project budget includes engineering fees to perform GSA for proposed retaining walls. We understand that a preliminary review of the proposed site grading provided by LAN suggests that structural retaining walls requiring CoSA retaining wall permits are not anticipated at this time.

If changes to the planned site grading occur that will require the design and construction of retaining walls, we should be contacted to provide GSA for the planned retaining walls to determine if the wall system(s) has an acceptable factor of safety against global instability. If needed, Arias will provide additional analysis as a supplement to this report.

Erosion Control

The performance of the proposed culvert bridge system will be related to the control of erosion. Erosion control should be provided for embankment slopes, drainage ditches, culverts, and retaining walls. Additionally, protection against scour should be provided for retaining wall footings and culvert outlets. The final grades should be established so that surface runoff and rising waters do not erode and adversely impact the proposed improvements. Some potential erosion control methods are presented below. Actual measures for erosion and scour control should be determined by the project civil engineer.

- Rock Riprap
- Gabions and Slope Mattresses
- Concrete Lining
- Erosion Control Mats

Consideration should be given to using “turn-downs” and “cut-off-walls” with the erosion control methods. Care should be taken to provide adequate anchorage for the erosion control methods.

Excavations

The contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, dated October 31, 1989. Such regulations are strictly enforced and, if not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties. The soils encountered at this site were classified as to type in accordance with this publication and are shown subsequently in Table 10.

Table 10: OSHA Soil Classifications

Stratum	Description	OSHA Classification
I	FAT CLAY (CH) with varying amounts of gravel; very stiff to hard; dark brown	C
II	SANDY LEAN CLAY (CL), LEAN CLAY (CL); stiff to hard; and CLAYEY GRAVEL with Sand (GC); medium dense to very dense; reddish brown, light tan, tan and brown	C
III	FAT CLAY (CH), LEAN CLAY (CL) with varying amounts of sand; very stiff to hard; tan, light tan, light gray, with calcareous deposits; becomes partially cemented with depth as encountered in the deeper Borings B-3 and B-4	B

****It must be noted that layered slopes cannot be steeper at the top than the underlying slope and that all materials below the water table must be classified as Type "C" soils. The OSHA publication should be referenced for layered soil conditions, benching, etc.**

For excavations less than 20 feet deep, the maximum allowable slope for Type "C" soils is 1.5H:1V (34°), for Type "B" soils is 1H:1V (45°) and for Type "A" soils is ¾H:1V (53°). It should be noted that the table and allowable slopes above are for temporary slopes. Permanent slopes at this site should be sloped no steeper than 4H:1V and flatter slopes may be required in gravelly/sandy areas. Flatter slopes may also be desired for mowing purposes.

It should be noted that heavy duty excavating equipment would be required for excavating in the hard and dense, as well as partially-cemented, materials encountered at this site. The contractor should provide such heavy duty excavating equipment.

Appropriate trench excavation methods will depend on the various soil and groundwater conditions encountered. We emphasize that undisclosed soil conditions may be present at locations and depths other than those encountered in our borings. Consequently, flatter slopes and dewatering techniques may be required in these areas.

The soils and rock to be penetrated by excavations may vary significantly across the site. Our preliminary soil classification is based solely on the materials encountered in the single boring. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that Arias be contacted immediately to evaluate the conditions encountered.

Trenches less than 5 feet deep are generally not required to be sloped back or braced following federal OSHA requirements for excavations. Sides of temporarily vertical excavations less than 5 feet deep may stay open for short periods of time; however, the soils that will be encountered in trench excavations are subject to random caving and sloughing. If side slopes begin to slough, the sides should be either braced or be sloped back to at least 1V: 1H, or flatter, as needed.

If any excavation, including a utility trench, is extended to a depth of more than twenty (20) feet, it will be necessary to have the side slopes designed by a professional engineer registered in Texas. As a safety measure, it is recommended that all vehicles and soil piles be kept a minimum lateral distance from the crest of the slope equal to no less than the slope height.

Specific surcharge loads such as traffic, heavy cranes, earth stockpiles, pipe stacks, etc., should be considered by the Trench Safety Engineer. It is also important to consider any vibratory loads such as heavy truck traffic.

It is required by OSHA that the excavations be carefully monitored by a competent person making daily construction inspections. These inspections are required to verify that the excavations are constructed in accordance with the intent of OSHA regulations and the Trench Safety Design. If deeper excavations are necessary or if actual soil conditions vary from the borings, the trench safety design may have to be revised. It is especially important for the inspector to observe the effects of changed weather conditions, surcharge loadings, and cuts into adjacent backfills of existing utilities. The flow of water into the base and sides of the excavation and the presence of any surface slope cracks should also be carefully monitored by the Trench Safety Engineer.

The bottoms of trench excavations should expose strong competent soils, and should be dry and free of loose, soft, or disturbed soil. If fill soils are encountered at the base of trench excavations, their competency should be verified through probing and density testing. Soft, wet, weak, or deleterious materials should be overexcavated to expose strong competent soils. At locations where soft or weak soils extend for some depth, overexcavation to stronger soils may prove infeasible and/or uneconomical. In the event of encountering these areas of deep soft or weak soils, we recommend that the bottom of the trench be evaluated by the contractor's Trench Safety Engineer and the project Geotechnical Engineer.

PAVEMENT CONSTRUCTION CRITERIA

Site Preparation

Topsoil stripping should be performed as needed to remove existing asphalt, concrete, base, organic materials, loose soils, vegetation, roots, and stumps. A minimum depth of 3 to 4 inches should be planned. Additional excavation may be required due to encountering deleterious materials such as concrete, organics, debris, soft materials, etc.

Lime-Treated Subgrade

We recommend that the high plasticity clay subgrade be treated the specified thickness with lime by dry weight in accordance with City of San Antonio Standard Specifications for Construction, Item 108, "Lime Treated Subgrade". Based on the results of our lime series testing we estimate that about 6 to 8 percent lime (by dry weight) will be required.

We recommend that the subgrade soils encountered at the time of construction be reviewed to evaluate the consistency of the subgrade conditions along the project alignment. Localized areas may require different amounts of lime. The final amounts of lime required for stabilization should be determined at the time of construction to confirm the values indicated as part of this design study.

The quantity of lime should be sufficient to obtain: (1) a pH of 12.4 or the highest pH achieved in accordance with TxDOT's standard test procedure TEX-121-E, (2) a PI of less than 20 with TxDOT's standard test procedure TEX-106-E, (3) an unconfined compressive strength of at least 50 psi with TxDOT's standard test procedure TEX-121-E, Part I, and (4) a swell value of less than 1% when tested by ASTM D4546 *Standard Test Methods for One-Dimensional Swell or Settlement Potential of Cohesive Soils*.

For the purposes of lime treatment, the dry weight of the high plasticity clay soils may be taken as 105 pounds per cubic foot (pcf). The amount of lime required may vary over the site. The limed soil should be compacted to at least 95 percent of the standard Proctor maximum dry density as evaluated by TEX-114-E at moisture contents ranging from optimum to plus four (+4) percentage points of optimum moisture content. Compaction tests should be performed as outlined in the Quality Assurance Testing section of this report.

Roadway Fill Requirements

The general fill used to increase sections of the roadway grade should consist of onsite materials meeting or exceeding the existing subgrade CBR value. The general fill should be placed in accordance with City of San Antonio Standard Specifications for Construction, Item 107, "Embankment". The compaction should be performed in accordance with the "Density Control" method. Onsite material may be used provided it is placed in maximum 8" loose lifts and compacted to at least 95 percent of the maximum dry density as evaluated by TEX-114-E to within optimum to plus four (+4) percent of optimum moisture (PI>35). This fill should

not have any organics or deleterious materials. When fill material includes rock, the maximum rock size acceptable shall be 3-inches. No large rocks (>3 inches) shall be allowed to nest and all voids must be carefully filled with small stones or earth and properly compacted.

The CBR of all fill materials used should be equal to or exceed the existing subgrade CBR (*i.e.,* assumed to be 2.2) at each particular location. The suitability of all fill materials should be approved by the Geotechnical Engineer. Conformance testing during construction to assure quality will be necessary for this process. If fill is required to raise paving grades, the above compaction criteria should be utilized with the fill placed in maximum 8-inch thick loose lifts. It should be noted that if fill materials with lower CBR values are placed, then a higher Structural Number and a thicker pavement section would be necessary.

Flexible Base Course

The base material should comply with City of San Antonio Standard Specifications for Construction, Item 200, "Flexible Base", Type A Grade 1 or 2. The compaction should be performed in accordance with the "Density Control" method. The flexible base should be compacted in maximum 8-inch loose lifts to at least 95 percent of the maximum dry density as evaluated by TEX-113-E within plus or minus 3 percent of optimum moisture content. Compaction tests should be performed as outlined in the "Quality Assurance Testing" section of this report.

Asphaltic Base Course

The asphalt should comply with City of San Antonio Standard Specifications for Construction, Item 205, "Hot Mix Asphaltic Concrete Pavement", Type B, Base Course. Compaction tests should be performed as outlined in the "Quality Assurance Testing" section of this report.

Asphaltic Concrete Surface Course

The asphalt should comply with City of San Antonio Standard Specifications for Construction, Item 205, "Hot Mix Asphaltic Concrete Pavement", Type C or D, Surface Course. Compaction tests should be performed as outlined in the "Quality Assurance Testing" section of this report.

Curb and Gutter

It has been our experience that pavements typically perform at a higher level when designed with adequate drainage including the implementation of curb and gutter systems. Accordingly, we recommend that curb and gutters be considered for this project. Furthermore, to aid in reducing the chances for water to infiltrate into the pavement base course and pond on top of the pavement subgrade, we highly recommend that pavement curbs be designed to extend through the pavement base course penetrating at least 6 inches

into the onsite subgrade. If water is allowed to infiltrate beneath the site pavements, frequent and premature pavement distress can occur.

Portions of the existing street currently have concrete curbs and gutters. We understand that the project will include the construction of curbs and gutters. Based on observations made at the time of our site visit, several areas where existing trees are located directly adjacent to the planned site improvements were visible. Tree roots will affect the moisture of the supporting soils and may result in movements to the newly constructed curbs.

Construction Site Drainage

We recommend that areas along the roadways be properly maintained to allow for positive drainage as construction proceeds and to keep water from ponding adjacent to the site pavements. This consideration should be included in the project specifications.

GENERAL COMMENTS

This report was prepared as an instrument of service for this project exclusively for the use of LAN, CoSA, and the project design team. If the development plans change relative to layout, anticipated traffic loads, or if different subsurface conditions are encountered during construction, we should be informed and retained to ascertain the impact of these changes on our recommendations. We cannot be responsible for the potential impact of these changes if we are not informed.

Design Review

Arias should be given the opportunity to review the design and construction documents. The purpose of this review is to check to see if our recommendations are properly interpreted into the project plans and specifications. Please note that design review was not included in the authorized scope and additional fees may apply.

Subsurface Variations

Soil and groundwater conditions may vary away from the sample boring locations. Transition boundaries or contacts, noted on the boring logs to separate soil types, are approximate. Actual contacts may be gradual and vary at different locations. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions or highly variable subsurface conditions are encountered during construction, we should be contacted to evaluate the significance of the changed conditions relative to our recommendations.

Quality Assurance Testing

The long-term success of the project will be affected by the quality of materials used for construction and the adherence of the construction to the project plans and specifications. As Geotechnical Engineer of Record (GER), we should be engaged by the Owner to provide

Quality Assurance (QA) testing. Our services will be to evaluate the degree to which constructors are achieving the specified conditions they're contractually obligated to achieve, and observe that the encountered materials during earthwork for foundation and pavement installation are consistent with those encountered during this study. In the event that Arias is not retained to provide QA testing, we should be immediately contacted if differing subsurface conditions are encountered during construction. Differing materials may require modification to the recommendations that we provided herein. A message to the Owner with regard to the project QA is provided in the ASFE publication included in Appendix F.

Arias has an established in-house laboratory that meets the standards of the American Standard Testing Materials (ASTM) specifications of ASTM E-329 defining requirements for Inspection and Testing Agencies for soil, concrete, steel and bituminous materials as used in construction. We maintain soils, concrete, asphalt, and aggregate testing equipment to provide the testing needs required by the project specifications. All of our equipment is calibrated by an independent testing agency in accordance with the National Bureau of Standards. In addition, Arias is accredited by the American Association of State Highway & Transportation Officials (AASHTO), the United States Army Corps of Engineers (USACE) and the Texas Department of Transportation (TxDOT), and also maintains AASHTO Materials Reference Laboratory (AMRL) and Cement and Concrete Reference Laboratory (CCRL) proficiency sampling, assessments and inspections.

Furthermore, Arias employs a technical staff certified through the following agencies: the National Institute for Certification in Engineering Technologies (NICET), the American Concrete Institute (ACI), the American Welding Society (AWS), the Precast/Prestressed Concrete Institute (PCI), the Mine & Safety Health Administration (MSHA), the Texas Asphalt Pavement Association (TXAPA) and the Texas Board of Professional Engineers (TBPE). Our services are conducted under the guidance and direction of a Professional Engineer (P.E.) licensed to work in the State of Texas, as required by law.

Guidelines for QA density testing are provided in Table 11 below.

Table 11: Density Test Guidelines for Roadway Elements

Element	Street Classification	Pavement Width	Frequency of Density Tests
Subgrade, Flexible Base, Asphaltic Base, Asphalt Course(s)	Secondary Arterial	60' or more	Every 100 Linear Feet for each Lift, or more frequent where materials visually appear to change

Standard of Care

Subject to the limitations inherent in the agreed scope of services as to the degree of care and amount of time and expenses to be incurred, and subject to any other limitations contained in the agreement for this work, Arias has performed its services consistent with that level of care and skill ordinarily exercised by other professional engineers practicing in the same locale and under similar circumstances at the time the services were performed.

Information about this geotechnical report is provided in the ASFE publication included in Appendix E.

APPENDIX A: FIGURES AND SITE PHOTOGRAPHS

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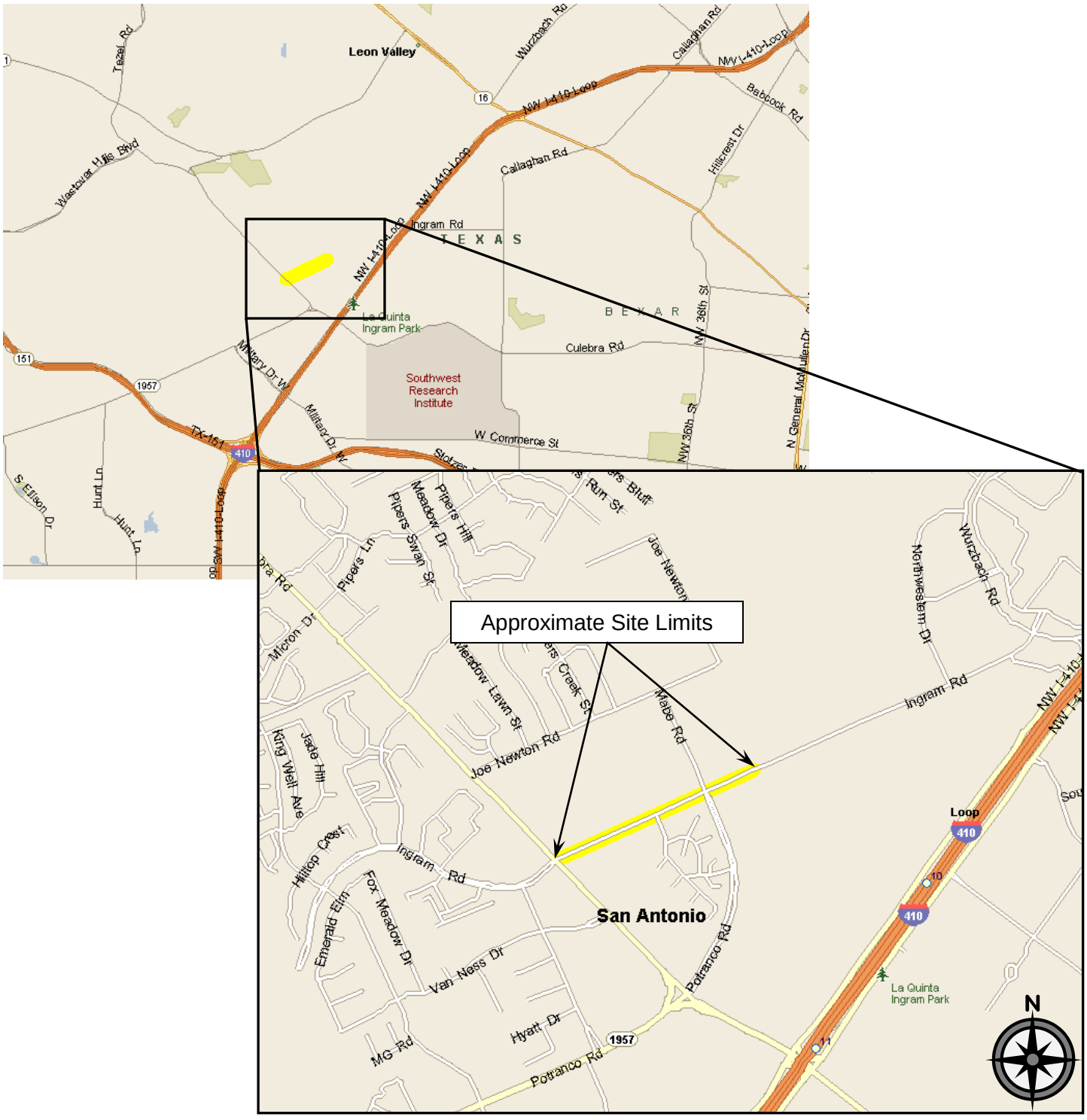

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VICINITY MAP

Ingram Road
from Culebra Road to 500-ft. east of Mabe Road
San Antonio, Texas

Date: July 9, 2013	Job No.: 2012-985
Drawn By: TAS	Checked By: RPG
Approved By: SAH	Scale: N.T.S.

Figure 1

DISCLAIMER: This drawing is for illustration only and should not be used for design or construction purposes. All locations are approximate.

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BORING LOCATION PLAN

Ingram Road
from Culebra Road to 500-ft. east of Mabe Road
San Antonio, Texas

REVISIONS:		
No.:	Date:	Description:

Date: July 9, 2013	Job No.: 2012-985
Drawn By: TAS	Checked By: RPG
Approved By: SAH	Scale: N.T.S.

Figure 2

DISCLAIMER: This drawing is for illustration only and should not be used for design or construction purposes. All locations are approximate.

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Photo 1 – View looking west at drilling operations of Boring B-1.

Photo 2 – View looking west at drilling operations of Boring B-2.

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SITE PHOTOS

Ingram Road
from Culebra Road to 500-ft. east of Mabe Road
San Antonio, Texas

Date: July 9, 2013	Job No.: 2012-985
Drawn By: TAS	Checked By: RPG
Approved By: SAH	Scale: N.T.S.

Appendix A

DISCLAIMER: This drawing is for illustration only and should not be used for design or construction purposes. All locations are approximate.

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Photo 3 – View west looking at drilling operations of Boring B-3.

Photo 4 – View west looking at drilling operations of Boring B-6.

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Office: (210) 308-5884 Fax: (210) 308-5886

SITE PHOTOS

Ingram Road
from Culebra Road to 500-ft. east of Mabe Road
San Antonio, Texas

Date: July 9, 2013	Job No.: 2012-985
Drawn By: TAS	Checked By: RPG
Approved By: SAH	Scale: N.T.S.

Appendix A

DISCLAIMER: This drawing is for illustration only and should not be used for design or construction purposes. All locations are approximate.

APPENDIX B: BORING LOGS AND KEY TO TERMS

Boring Log No. B-1

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'33.9" W98°38'17.3"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	-200	DD	Uc
9.5" Asphalt		AC							
6" Base		GB	2						
FAT CLAY (CH), very stiff, dark brown, with sand	2	T	23						
		T	19	20	63	43	77		
FAT CLAY (CH), hard, light tan	4								
-with calcareous deposits to 6'		T	21					106	3.02
	6								
		T	12	25	60	35	96		
	8								
		T	24					95	3.24
Borehole terminated at 9.5 feet									

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 9.5 ft

Nomenclature Used on Boring Log

Asphalt Core (AC)
Grab Sample (GB)
Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

Arias & Associates, Inc.

Job No.: 2012-985

2012-985.GPJ 7/22/13 (BORING LOG SA13-02.ARIASSA12-01.GDT.LIBRARY2012-02.GLB)

Boring Log No. B-2

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'35.9" W98°38'11.8"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200	DD	Uc
7" Asphalt		AC								
4" Base		GB	13							
FAT CLAY (CH), hard, dark brown		T	24	29	65	36				
-with gravel below 2'	2	T	22						109	7.05 L/D
CLAYEY GRAVEL (GC), dense, brown and tan, with sand	4									
-tan below 5'		SS	9				44			
FAT CLAY (CH), hard, light tan, with calcareous deposits	6									
	8	SS	18				32			
	10	SS	18	23	65	42	41	95		
Borehole terminated at 10 feet										

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

- Asphalt Core (AC)
- Grab Sample (GB)
- Thin-walled tube (T)
- Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

Arias & Associates, Inc.

Job No.: 2012-985

Boring Log No. B-3

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'37.6" W98°38'8.5"

Location: See Boring Location Plan

Backfill: Cuttings

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200	DD	Uc
FAT CLAY (CH), very stiff, dark brown		SS	20				19			
LEAN CLAY (CL), stiff, light tan, gravelly, with calcareous deposits		SS	18	21	33	12	9	55		
	5	SS	16				20			
		SS	12				44			
SANDY LEAN CLAY (CL), very stiff to hard, light tan, with gravel		SS	15	15	46	31	31	66		
	10	SS	27				25			
LEAN CLAY (CL), very stiff, light tan		T	37						78	3.13
	15									
-very hard (partially cemented), sandy, below 17'		SS	13	17	39	22	**50/3"	56		
	20									
		SS	9				**50/3"			
Borehole terminated at 23.8 feet										

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 23.8 ft

Nomenclature Used on Boring Log

Split Spoon (SS)
Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

Arias & Associates, Inc.

Job No.: 2012-985

Boring Log No. B-4

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'37.5" W98°38'7.9"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200	DD	Uc
8" Asphalt										
FAT CLAY (CH), very stiff, dark brown, with gravel		SS	27	31	68	37	20	82		
		T	20						94	1.13
LEAN CLAY (CL), hard, light tan	5	SS	9				**50/5"			
CLAYEY GRAVEL (GC), dense to very dense, light tan, with sand		SS	8				54			
	10	SS	7	15	45	30	79	31		
		SS	11				72			
LEAN CLAY (CL), very hard, light tan, partially cemented	15	SS	15				70/11"			
	20	SS	11				**50/5"	91		
		SS	11				**50/4"			
Borehole terminated at 23.8 feet										

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 23.8 ft

Nomenclature Used on Boring Log

Split Spoon (SS)

Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

** = Blow Counts During Seating Penetration
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

2012-985.GPJ 7/22/13 (BORING LOG SA13-02.ARIASSA12-01.GDT.LIBRARY2012-02.GLB)

Arias & Associates, Inc.

Job No.: 2012-985

Boring Log No. B-5

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'39.2" W98°38'3.5"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
6.75" Asphalt								
6" Base		AC	11					
FAT CLAY (CH), dark brown, with trace gravel	2	SS	10	28	72	44	25	34
CLAYEY GRAVEL (GC), medium dense to dense, light tan, with sand	4	SS	18				35	
LEAN CLAY (CL), very stiff, light tan, with calcarous deposits	6	SS	10				23	
-reddish brown, sandy, below 8'	8	SS	11	14	22	8	28	58
LEAN CLAY (CL), hard, light tan and white, with many calcareous deposits	10	SS	16				45	
Borehole terminated at 10 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

Asphalt Core (AC)

Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve

2012-985.GPJ 7/22/13 (BORING LOG SA13-02.ARIASSA12-01.GDT.LIBRARY2012-02.GLB)

Arias & Associates, Inc.

Job No.: 2012-985

Boring Log No. B-6

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'41.2" W98°37'59.2"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200
24" Asphalt	2	AC						
LEAN CLAY (CL), very stiff, light tan, with sand and calcareous deposits	4	SS	5 12	18	39	21	22	83
FAT CLAY (CH), hard, light tan, hard	6	SS	15				87/10"	
	8	SS	18				77	
-with calcareous deposits below 8'	10	SS	20	25	60	35	75	97
Borehole terminated at 10 feet								

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

Asphalt Core (AC) Split Spoon (SS)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count

-200 = % Passing #200 Sieve

Arias & Associates, Inc.

Job No.: 2012-985

2012-985.GPJ 7/22/13 (BORING LOG SA13-02.ARIASSA12-01.GDT.LIBRARY2012-02.GLB)

Boring Log No. B-7

Project: **Ingram Road**
from Culebra Rd. to 500 ft. east of Mabe/Potranco Rd.
San Antonio, Texas

Sampling Date: 6/6/13

Coordinates: N29°27'42.8" W98°37'54"

Location: See Boring Location Plan

Backfill: Backfill and patched

Soil Description	Depth (ft)	SN	WC	PL	LL	PI	N	-200	DD	Uc
11" Asphalt		AC								
CLAYEY GRAVEL (GC), brown, (with lime)		GB	9	26	41	15		34		
FAT CLAY (CH), very stiff, brown, with trace gravel	2	SS	17	19	51	32	18	72		
LEAN CLAY (CL), hard, reddish brown, with gravel	4	T	17						112	4.13
	6	T	17							
-gravelly, with sand below 8'	8	T	15	22	45	23		57		
Borehole terminated at 10 feet	10									

Groundwater Data:
During drilling: Not encountered

Field Drilling Data:
Coordinates: Hand-held GPS Unit
Logged By: R. Arizola
Driller: Eagle Drilling, Inc.
Equipment: Truck-mounted drill rig

Single flight auger: 0 - 10 ft

Nomenclature Used on Boring Log

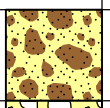
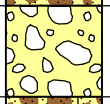
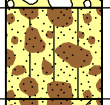
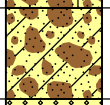
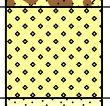
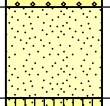
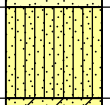
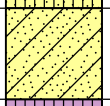
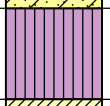
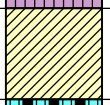
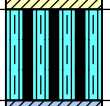
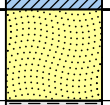
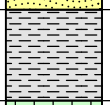
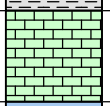
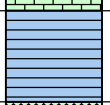
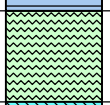
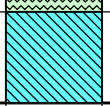
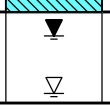
- Asphalt Core (AC)
- Split Spoon (SS)
- Grab Sample (GB)
- Thin-walled tube (T)

WC = Water Content (%)
PL = Plastic Limit
LL = Liquid Limit
PI = Plasticity Index
N = SPT Blow Count
-200 = % Passing #200 Sieve
DD = Dry Density (pcf)
Uc = Compressive Strength (tsf)

Arias & Associates, Inc.

Job No.: 2012-985

KEY TO CLASSIFICATION SYMBOLS USED ON BORING LOGS

MAJOR DIVISIONS			GROUP SYMBOLS		DESCRIPTIONS
COARSE-GRAINED SOILS More Than Half of Material LARGER Than No. 200 Sieve size	GRAVELS More Than Half of Coarse Fraction is LARGER Than No. 4 Sieve Size	Clean Gravels (Little or no Fines)	GW		Well-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
			GP		Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels With Fines (Appreciable Amount of Fines)	GM		Silty Gravels, Gravel-Sand-Silt Mixtures
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS More Than Half of Coarse Fraction is SMALLER Than No. 4 Sieve Size	Clean Sands (Little or no Fines)	SW		Well-Graded Sands, Gravelly Sands, Little or no Fines
			SP		Poorly-Graded Sands, Gravelly Sands, Little or no Fines
		Sands With Fines (Appreciable Amount of Fines)	SM		Silty Sands, Sand-Silt Mixtures
			SC		Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size	SILTS & CLAYS	Liquid Limit Less Than 50	ML		Inorganic Silts & Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
	SILTS & CLAYS	Liquid Limit Greater Than 50	MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils, Elastic Silts
			CH		Inorganic Clays of High Plasticity, Fat Clays
FORMATIONAL MATERIALS	SANDSTONE				Massive Sandstones, Sandstones with Gravel Clasts
	MARLSTONE				Indurated Argillaceous Limestones
	LIMESTONE				Massive or Weakly Bedded Limestones
	CLAYSTONE				Mudstone or Massive Claystones
	CHALK				Massive or Poorly Bedded Chalk Deposits
	MARINE CLAYS				Cretaceous Clay Deposits
	GROUNDWATER				Indicates Final Observed Groundwater Level Indicates Initial Observed Groundwater Location

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APPENDIX C: LABORATORY AND FIELD TEST PROCEDURES

FIELD AND LABORATORY EXPLORATION

The field exploration program included drilling at selected locations within the site and intermittently sampling the encountered materials. The boreholes were drilled using either single flight auger (ASTM D 1452) or hollow-stem auger (ASTM D 6151). Samples of encountered materials were obtained using a split-barrel sampler while performing the Standard Penetration Test (ASTM D 1586), using a thin-walled tube sampler (ASTM D 1587), or by taking material from the auger as it was advanced (ASTM D 1452). The sample depth interval and type of sampler used is included on the soil boring log. Arias' field representative visually logged each recovered sample and placed a portion of the recovered sampled into a plastic bag for transport to our laboratory.

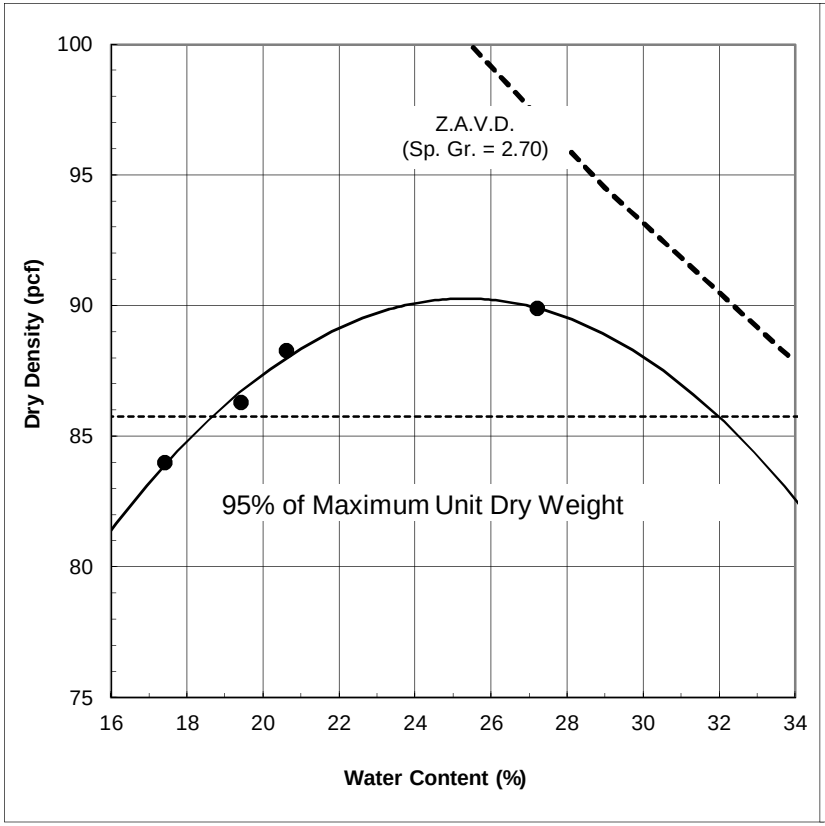
SPT N values and blow counts for those intervals where the sampler could not be advanced for the required 18-inch penetration are shown on the soil boring log. If the test was terminated during the 6-inch seating interval or after 10 hammer blows were applied used and no advancement of the sampler was noted, the log denotes this condition as blow count during seating penetration. Penetrometer readings recorded for thin-walled tube samples that remained intact also are shown on the soil boring log.

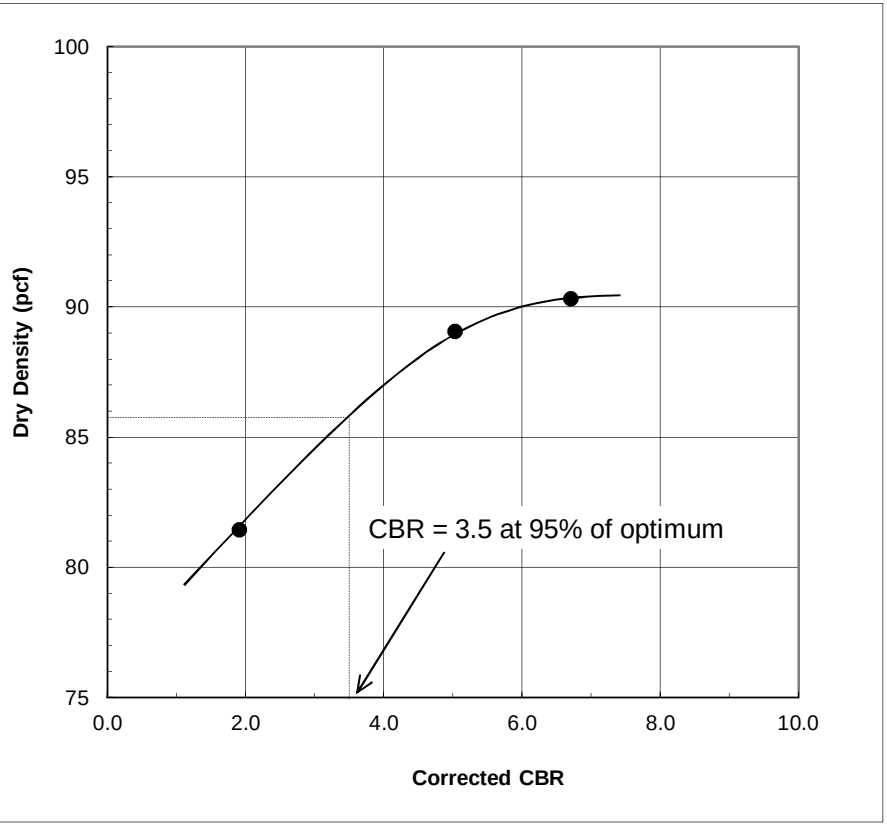
Arias performed soil mechanics laboratory tests on selected samples to aid in soil classification and to determine engineering properties. Tests commonly used in geotechnical exploration, the method used to perform the test, and the column designation on the boring log where data are reported are summarized as follows:

Test Name	Test Method	Log Designation
Water (moisture) content of soil and rock by mass	ASTM D 2216	WC
Liquid limit, plastic limit, and plasticity index of soils	ASTM D 4318	PL, LL, PI
Amount of material in soils finer than the No. 200 sieve	ASTM D 1140	-200
Particle size analysis of soils (with or without fines fraction)	ASTM D 422	--
Sulfate Content in Soils	TEX 145-E	--
Moisture-Density Relationship	ASTM D 698	--
California Bearing Ratio	ASTM D 1883	--

The laboratory results are reported on the soil boring logs.

APPENDIX D: BULK SAMPLE TEST RESULTS





Sample: 13-460
Test Method: ASTM D698 Method C
Material: Dark Brown Fat Clay

Optimum Water Content:	25.3 %
Maximum Unit Dry Weight:	90.3 pcf
Liquid Limit:	61
Plasticity Index:	35
% Passing #200 Sieve:	86

	% SWELL
72 blows:	1.0
56 blows:	1.2
25 blows:	2.5

MOISTURE-DENSITY AND CBR TEST RESULTS
Ingram Road
San Antonio, Texas

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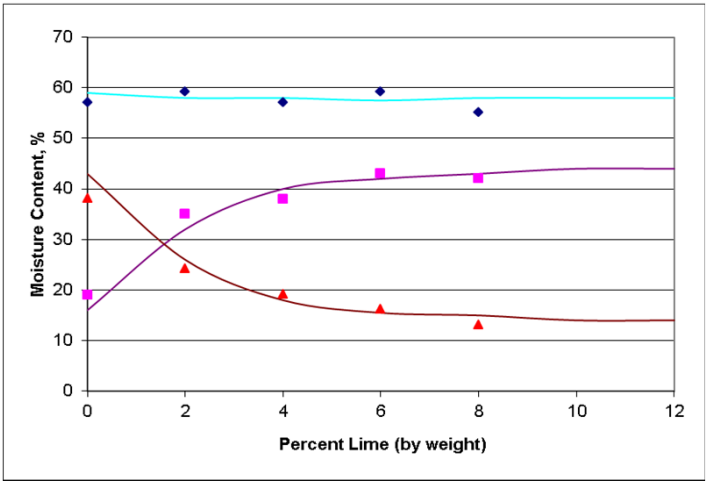

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Geotechnical • Environmental • Testing
TBPE Registration No. F-32
142 Chula Vista
San Antonio, Texas 78232
Office: (210) 308-5884 Fax: (210) 308-5886

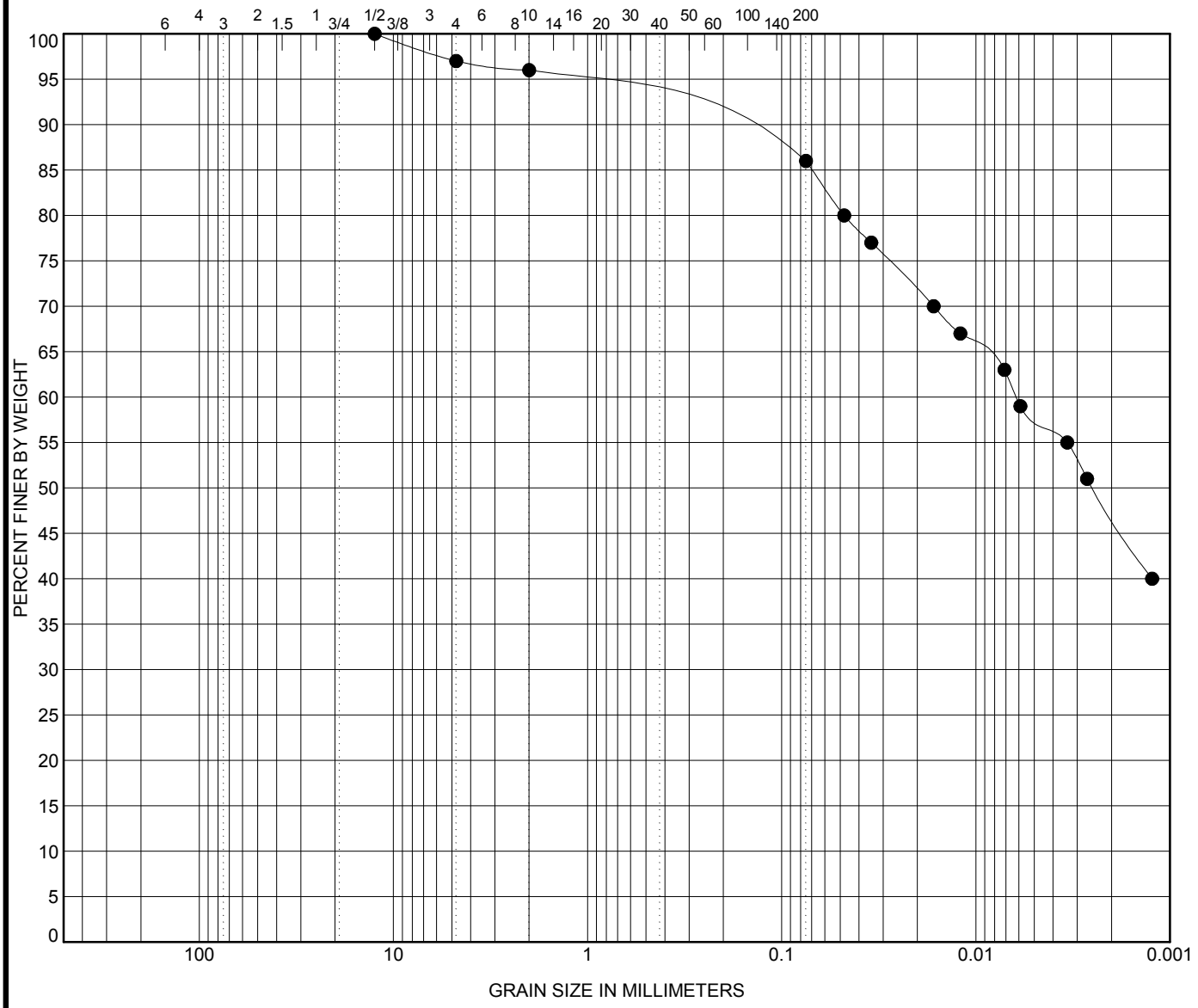
LIME SERIES RESULTS

Ingram Road
from Culebra Rd to 500-ft east of Mabe Road
San Antonio, Texas

Date: July 8, 2013	Job No.: 2012-985
Drawn By: RPG	Checked By: SAH
Approved By: SAH	Scale: N.T.S.

Figure 5

DISCLAIMER: This drawing is for illustration only and should not be used for design or construction purposes. All locations are approximate.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Elev	Depth	Classification	LL	PL	PI	Cc	Cu
●	**Bulk Sample**		**0.0**	**FAT CLAY (CH)**	**61**	**26**	**35**		

	Boring	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Bulk Sample**	**0.0**	**12.5**	**0.006**			**3.0**	**11.0**	**39.1**	**46.9**

Silt and clay fractions were determined using 0.002 mm as the maximum particle size for clay.

142 Chula Vista
San Antonio, Texas 78232
Phone: (210) 308-5884
Fax: (210) 308-5886

GRAIN SIZE DISTRIBUTION

Project: Ingram Road

Location: See Boring Location Plan

Job No.: 2012-985

2012-985.GPJ 7/22/13 (GRAIN SIZE ARIAS.US LAB.GDT.LIBRARY2012-02.GLB)

APPENDIX E: ASFE INFORMATION – GEOTECHNICAL REPORT

Important Information about Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE
THE BEST PEOPLE ON EARTH

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APPENDIX F: PROJECT QUALITY ASSURANCE

A Message to Owners

Construction materials engineering and testing (CoMET) consultants perform quality-assurance (QA) services to evaluate the degree to which constructors are achieving the specified conditions they're contractually obligated to achieve. Done right, QA can save you time and money; prevent unanticipated-conditions claims, change orders, and disputes; and reduce short-term and long-term risks, especially by detecting molehills before they grow into mountains.

Done right, QA can save you time and money; prevent claims and disputes; and reduce risks. Many owners don't do QA right because they follow bad advice.

Many owners don't do QA right because they follow bad advice; e.g., "CoMET consultants are all the same. They all have accredited facilities and certified personnel. Go with the low bidder." But there's no such thing as a standard QA scope of service, meaning that – to bid low – each interested firms *must* propose the cheapest QA service it can live with, jeopardizing service quality and aggravating risk for the entire project team. Besides, the advice is based on misinformation.

Fact: ***Most CoMET firms are not accredited***, and the quality of those that are varies significantly. Accreditation – which is important – nonetheless means that a facility met an accrediting body's minimum criteria. Some firms practice at a much higher level; others just barely scrape by. And what an accrediting body typically evaluates – management, staff, facilities, and equipment – can change substantially before the next review, two, three, or more years from now.

Most CoMET firms are not accredited. It's dangerous to assume CoMET personnel are certified.

Fact: ***It's dangerous to assume CoMET personnel are certified.*** Many have no credentials at all; some are certified by organizations of questionable merit, while others have a valid certification, but *not* for the services they're assigned.

Some CoMET firms – the "low-cost providers" – *want* you to believe that price is the only difference between QA providers. It's not, of course. Firms that sell low price typically lack the facilities, equipment, personnel, and insurance quality-oriented firms invest in to achieve the reliability concerned owners need to achieve quality in quality assurance.

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Firms that sell low price typically lack the facilities, equipment, personnel, and insurance quality-oriented firms invest in to achieve the reliability concerned owners need to achieve quality in quality assurance.

To derive maximum value from your investment in QA, require the CoMET firm's project manager to serve actively on the project team from beginning to end, a level of service that's relatively inexpensive and can pay huge dividends. During the project's planning and design stages, experienced CoMET professionals can help the design team develop uniform technical specifications and establish appropriate observation, testing, and instrumentation procedures and protocols. They can also analyze plans and specs much as constructors do, looking for the little errors, omissions, conflicts, and ambiguities that often become the basis for big extras and big claims. They can provide guidance about operations that need closer review than others, because of their criticality or potential for error or abuse. They can also relate their experience with the various constructors that have expressed interest in your project.

To derive maximum value, require the project manager to serve actively on the project team from beginning to end.

CoMET consultants' construction-phase QA services focus on two distinct issues: those that relate to geotechnical engineering and those that relate to the other elements of construction.

The geotechnical issues are critically important because they are essential to the "observational method" geotechnical engineers use to significantly reduce the amount of sampling they'd otherwise require. They apply the observational method by developing a sampling plan for a project, and then assigning field representatives to ensure samples are properly obtained, packaged, and transported. The engineers review the samples and, typically, have them tested in their own laboratories. They use the information they derive to characterize the site's subsurface and develop *preliminary* recommendations for the structure's foundations and for the specifications of various "geo" elements, like excavations, site grading, foundation-bearing grades, and roadway and parking-lot preparation and surfacing.

Geotechnical engineers cannot finalize their recommendations until they or their field representatives are on site to observe what's excavated to verify that the subsurface conditions the engineers predicted are those that actually exist.

When unanticipated conditions are observed, recommendations and/or specifications should be modified.

Responding to client requests, many geotechnical-engineering firms have expanded their field-services mix, so they're able to perform overall construction QA, encompassing – in addition to geotechnical issues – reinforced concrete, structural steel, welds, fireproofing, and so on. Unfortunately, that's caused some confusion. Believing that all CoMET consultants are alike, some owners take bids for the overall CoMET package, including the geotechnical field observation. *Entrusting geotechnical field observation to someone other than the geotechnical engineer of record (GER) creates a significant risk.*

Geotechnical engineers cannot finalize their recommendations until they are on site to verify that the subsurface conditions they predicted are those that actually exist. Entrusting geotechnical field observation to someone other than the geotechnical engineer of record (GER) creates a significant risk.

GERs have developed a variety of protocols to optimize the quality of their field-observation procedures. Quality-focused GERs meet with their field representatives before they leave for a project site, to brief them on what to look for and where, when, and how to look. (***No one can duplicate this briefing***, because no one else knows as much about a project's geotechnical issues.) And once they arrive at a project site, the field representatives know to maintain timely, effective communication with the GER, because that's what the GER has trained them to do. By contrast, it's extremely rare for a different firm's field personnel to contact the GER, even when they're concerned or confused about what they observe, because they regard the GER's firm as "the competition."

Divorcing the GER from geotechnical field operations is almost always penny-wise and pound-foolish. Still, because owners are given bad advice, it's commonly done, helping to explain why ***"geo" issues are the number-one source of construction-industry claims and disputes.***

Divorcing the GER from geotechnical field operations is almost always penny-wise and pound-foolish, helping to explain why "geo" issues are the number-one source of construction-industry claims and disputes.

To derive the biggest bang for the QA buck, identify three or even four quality-focused CoMET consultants. (If you don't know any, use the "Find a Geoprofessional" service available free at www.asfe.org.) Ask about the firms' ongoing and recent projects and the clients and client representatives involved; *insist upon receiving verification of all claimed accreditations, certifications, licenses, and insurance coverages.*

Insist upon receiving verification of all claimed accreditations, certifications, licenses, and insurance coverages.

Once you identify the two or three most qualified firms, meet with their representatives, preferably at their own facility, so you can inspect their laboratory, speak with management and technical staff, and form an opinion about the firm's capabilities and attitude.

Insist that each firm's designated project manager participate in the meeting. You will benefit when that individual is a seasoned QA professional familiar with construction's rough-and-tumble. Ask about others the firm will assign, too. There's no substitute for experienced personnel who are familiar with the codes and standards involved and know how to:

- read and interpret plans and specifications;
- perform the necessary observation, inspection, and testing;
- document their observations and findings;
- interact with constructors' personnel; and
- respond to the unexpected.

Important: Many of the services CoMET QA field representatives perform – like observing operations and outcomes – require the good judgment afforded by extensive training and experience, especially in situations where standard operating procedures do not apply. You need to know who will be exercising that judgment: a 15-year "veteran" or a rookie?

Many of the services CoMET QA field representatives perform require good judgment.

Also consider the tools CoMET personnel use. Some firms are passionate about proper calibration; others, less so. Passion is a good thing! Ask to see the firm's calibration records. If the firm doesn't have any, or if they are not current, be cautious. *You cannot trust test results derived using equipment that may be out of calibration.* Also ask a firm's representatives about their reporting practices, including report distribution, how they handle notifications of nonconformance, and how they resolve complaints.

Scope flexibility is needed to deal promptly with the unanticipated.

For financing purposes, some owners require the constructor to pay for CoMET services. ***Consider an alternative approach*** so you don't convert the constructor into the CoMET consultant's client. If it's essential for you to fund QA via the constructor, have the CoMET fee included as an allowance in the bid documents. This arrangement ensures that you remain the CoMET consultant's client, and it prevents the CoMET fee from becoming part of the constructor's bid-price competition. (Note that the International Building Code (IBC) *requires the owner to pay* for Special Inspection (SI) services commonly performed by the CoMET consultant as a service separate from QA, to help ensure the SI services' integrity. Because failure to comply could result in denial of an occupancy or use permit, having a contractual agreement that conforms to the IBC mandate is essential.)

If it's essential for you to fund QA via the constructor, have the CoMET fee included as an allowance in the bid documents. Note, too, that the International Building Code (IBC) requires the owner to pay for Special Inspection (SI) services.

CoMET consultants can usually quote their fees as unit fees, unit fees with estimated total (invoiced on a unit-fee basis), or lump-sum (invoiced on a percent-completion basis referenced to a schedule of values). No matter which method is used, estimated quantities need to be realistic. Some CoMET firms lower their total-fee estimates by using quantities they know are too low and then request change orders long before QA is complete.

Once you and the CoMET consultant settle on the scope of service and fee, enter into a written contract. Established CoMET firms have their own contracts; most owners sign them. Some owners prefer to use different contracts, but that can be a mistake when the contract was prepared for construction services. *Professional services are different.* Wholly avoidable problems occur when a contract includes provisions that don't apply to the services involved and fail to include those that do.

Some owners create wholly avoidable problems by using a contract prepared for construction services.

This final note: CoMET consultants perform QA for owners, not constructors. While constructors are commonly allowed to review QA reports as a *courtesy*, you need to make it clear that constructors do *not* have a legal right to rely on those reports; i.e., if constructors want to forgo their own observation and testing and rely on results derived from a scope created to meet *only* the needs of the owner, they *must do so at their own risk*. In all too many cases where owners have not made that clear, some constructors have alleged that they did have a legal right to rely on QA reports and, as a result, the CoMET consultant – not they – are responsible for their failure to deliver what they contractually promised to provide. The outcome can be delays and disputes that entangle you and all other principal project participants. Avoid that. Rely on a CoMET firm that possesses the resources and attitude needed to manage this and other risks as an element of a quality-focused service. Involve the firm early. Keep it engaged. And listen to what the CoMET consultant says. A good CoMET consultant can provide great value.

For more information, speak with your ASFE-Member CoMET consultant or contact ASFE directly.

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END OF ADDENDUM No. 2

City of San Antonio

TRANSPORTATION AND CAPITAL IMPROVEMENTS

RECEIPT OF ADDENDUM NUMBER(S) **2** IS HEREBY ACKNOWLEDGED FOR THE PROJECT: **INGRAM ROAD (CULEBRA RD TO MABE RD) WBS#40-00307**

FOR WHICH PROPOSAL WILL BE OPENED AND READ ALOUD ON: **October 28, 2014 at 2:00 P.M.**

*****THIS ACKNOWLEDGEMENT MUST BE SIGNED AND RETURNED WITH THE PROPOSAL PACKAGE.*****

Company Name: _____

Address: _____

City/State/Zip Code: _____

Date: _____

_____
Signature

_____
Print Name/Title